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PROFITABLE INDUSTRIES.

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PROFITABLE INDUSTRIES

A detailed description of Small Industries turning Articles of Daily Needs and capable of being manufactured by Small Capitalists with Profit

By

AN INDUSTRIAL EXPERT

INDUSTRY BOOK DEPT,

KESHUB BHABAN,

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N B—The pages from 65—80 have been wrongly marked as 49—64 for the second time

PROFITABLE INDUSTRIES

INTRODUCTION.

WITH the unprecedented progress of the arts and sciences in the modern age, the standard of living is moving up universally. The under-current of the world's new tendencies has already set afoot in India. Her mode of living is undergoing perceptible changes in all the spheres of life, and articles which were so long considered to be of little general use to the countrymen and meant for luxury only, have now come to be articles of daily necessity.

The credit of popularising these all over the world must go to the Westerns. They taxed their inventive genius and technical skill to the highest to produce articles which will combine both efficiency and comfort. As a natural consequence it is they who have been able to be the pioneer manufacturers of most of the daily necessaries of life on a big scale, and their aggressive

business methods and world wide advertisements have brought these into fashion in India

There cannot be any doubt that many of these articles can be made in India with a little practical training by utilizing the various raw materials available in the country, and it is incumbent on the Indian economists to investigate properly which of these articles are capable of being manufactured on the Indian soil under the conditions now prevailing in the country

In appraising the suitability of the various industries, a critical analysis of the following factors is to be undertaken —

(1) Whether the capital required as initial outlay and for meeting the recurring expenses can be raised in the country and falls within the means of the prospective manufacturers

(2) Whether properly trained workers are available for the various operations of the industry

(3) Whether the cost of machinery is justified by its capacity, working cost and wear and tear

(4) Whether raw materials required for the industry can be had cheaply and abundantly and whether the supply of the materials is regular

(5) Whether the outturn and the cost of production including selling charges would render the manufactury a commercial success

(6) Whether there is a steady demand for the articles of production with special reference to the market, competition, future prospects, etc.

(7) Whether the waste materials can be utilised in the manufacture of by products or can be disposed of in the market.

(8) Whether expert knowledge regarding the process of manufacture is available in the country

There are, besides, many other subsidiary factors which require consideration, such as, scope for expansion, depreciation funds, customs duties, location of the factories, the means of transport, the motive power, etc., etc.

Considered from all angles of view, small industries turning articles of our daily needs seem to possess great potentialities Banking facilities and joint stock enterprice being not sufficiently organised, small industries requiring no investment of huge capitals will seem to possess chances of thriving all over the country

It has been our purpose in this book to indicate some of lines of developments Old industries are now in a decaying state and it is the height of wisdom to transfer our energy to the manufacture of things which are in keen demand and thus add a new tone to the Indian economic structure It is a matter of vital

importance, and to a country intent upon carving out an economically sound career nothing would be of greater value than to study the modern requirements and march with the times by taking up new industries and introducing innovations as demanded by public taste and culture

We do not claim our list to be exhaustive, the number of small industries which present chances of being conducted successfully with comparatively small capital without much technical knowledge or skill could easily be multiplied, for example, manufacture may be taken of hosiery goods, laces, tapes, card board boxes, toys and dolls, brooches, thread balls, wire and sheet metal goods, leather cases, umbrellas, penholders, buckets from galvanised sheets, trunks, cans, utensils from brass sheets, etc., etc Lots of similar articles can be turned out with small machines, and there is every reason to believe that a net work of thriving small industries all over the country will lay the foundation of an economically prosperous India.

MANUFACTURE OF BRUSHES.

AS civilisation is advancing and the standard of living of mankind is rising up, a wide range of brushes for all conceivable and inconceivable purposes has become in some cases a necessity and in others a luxury Their services are requisitioned whenever any thing is to be scraped or cleaned These are now employed in a wide range of industries as well as to serve household purposes. Brush making has, therefore, become a lucrative business Moreover, there are some salient features in it. The brush manufacture is chiefly a domestic one, and is well adapted for the employment of females and children whose labour is abundant and idle in this country The same remark applies in a greater degree to the raw materials which are prolific and untapped. The most potent consideration is, how ever, that this trade may be carried on upon almost any scale, according to the capital at command A man may even start alone with half a dozen tools and fifty rupees in his pocket

Materials

A great variety of substances has been requisitioned for the manufacture of brushes of which there are innumerable kinds to suit different arts and crafts. Of

these bristles and hair form the chief ingredients For example, brushes intended for scrubbing metallic surfaces are made of wire, while those for use in contact with acids are of spun glass[1] For coarse work where elasticity is not required, rattan, reeds and such other plants are employed The roots and fibres of many tropical plants are also employed for this purpose, coconut husks being a case in point

Again, for those smaller brushes which are known to the trade as pencils and are used in water colour and some kinds of house, sign and coach painting, feathers are employed as well as hair of camel, squirrel, goat, horse and similar articles These are carefully selected and judiciously sorted The whitest and best hogs' bristles are used in hair, tooth, clothes, hat and the best paint brushes.

CLASSIFICATION OF BRUSH MATERIALS

It should be here mentioned that the materials used in the making of brushes may be broadly divided into two classes, viz. those of animal origin and those of vegetable origin. Bristles form the most important article under brush materials and are used in the manufacture of the best varieties of products where excellence of quality is a deciding factor Bristles are stiff hairs of various mammals, especially those of the wild boar and the hog, and are also made use of by

the shoemakers and the saddlers In India however the bristles used are chiefly hog's bristles. Hair of numer ous animals are also sometimes used The principal materials of vegetable origin used for the purpose are the fibres of the palmyra, the coconut, the aloe, esparto glass and the like In this connection it should also be remarked that brushes of steel and brass wire are manu factured for particular purposes. All kinds of wood, ivory, tortoise shell and metal are used for the backs and the handles

INDIAN SOURCES OF BRUSH MATERIALS

According to *Sir George Watt* the following are some of the plants employed in brush making —

(1) *Arenga saccharifera* In vernacular language the fibre is known as *taung ong, eju, gumuti*, etc., and the coarsest variety is fit for brush making

(2) *Aristida setacea* The plant goes by the name of broom stick grass, *shipur gaddi, vina pullalu, thodapga pullu* The roots are said to be used in the manufacture of weavers' brushes in Madras and along the West Coast.

(3) *Agave cantala or Bombay aloe fibre* The plant is common in hedges and is frequent near Bombay, in the northern portions of the Madras Presidency, in Central India and in the Gangetic plain generally,

as far north as the sub-mountain districts of the provinces of Agra and the Punjab but is absent from the arid strip between Gwalior and Delhi

(4) *Bambusa or the bamboo* The various species can be employed in the making of brushes, etc

(5) *Borassus flabellifer or the palmyra palm* This is the principal variety used in the making of brooms. The fibre is obtained from the leafy stalks of seedling palmyras, and the principal seats of extraction are the uplands of Kristna and Godavari and the Tinnevelly District and the Palghat subdivision of Malabar

(6) *Caryota urens* The plant in vernacular is called Indian sago palm, *mari, bherawa, conda panna, minbaw,* etc, and is widely distributed throughout the hotter parts of India from the Sikkim Himalaya and Assam to Ceylon and Singapore The plant gives rise to the strong *kittul* fibre of Ceylon This fibre has been found to be especially suitable for brush making and is now much in request in Europe The fibre is sometimes used instead of bristles in hair brushes, clothes brushes, horse brushes, etc

(7) *Chrysopogon Gryllus* The roots of this plant are said to be whisk fibre and is made into brushes of many kinds in England

(8) *Cocos nucifera or the coconut* The coconut plant yields important fibres for brooms, the shorter and

stuffer fibres being used for the purpose The best bristle fibre is stretched straight and cleaned and made up into small bundles

(9) *Ischaemum augustifolium* The plant in vernacular is known as *babui, bhadar, sabai, moya, bankai, som,* etc. It is a perennial grass plentiful in the drier tracts of India, from Chota Nagpur and Rajmahal to Nepal and Garhwal and also throughout the plains northward, viz in the Central Provinces, Central India and Rajputana to the Punjab and Kashmir This can also be made into ropes and mats

(10) *Pandanus odoratissimus or the screw pine* A common and much branched plant wild on the coast of South India. The roots are used for brush making

(11) *Phoenix sylvestris* This is otherwise known as the wild date and date sugar palm.

(12) *Saccharum arundinaceum or munj* It is the *sara* of the classic authors of India and is met with throughout the plains and lower hills

(13) *Sorghum vulgare or Indian millet* The plant grows in warmer, moister regions, as in Bengal, in large portions of Madras, in Lower Burma and the Ceylon and bears the vernacular names of *juar, jondhala, kurbi, chari, kangra, talla, jonna*

(14) *Vetiveria zizanioides* The plant is found throughout the plains and lower hills of India, Burma and

Ceylon, occurring on moist, heavy soils, more especially on the margin of lakes or streams The root is known as *khas khas*

BRISTLES

Coming to brush materials of animal origin, we notice that hogs' bristles are the most in use Hair of bears, squirrels, camels, badgers, goats, polecats, sables, etc, is used in European brush industry but no information is available as to the extent, if any, to which India contributes to the supply herself or utilises any of the hairs mentioned

Bristles plucked as in the United Provinces from the living animals are rated superior to those obtained from carcasses They are of various colours but before being used for brush making they are sorted into black, grey, yellow, white and lilies The bristles vary from 3 to 10 inches in length, the moderately long being better than the very long The white are better than the yellow, and the yellow better than the black, the wiry are better than the limp Other things being equal, the thickest bristles are the most sought after, and are considered to be the best for brush making

PRELIMINARY TREATMENT

The bristles are generally put on the market well washed and clean Nevertheless, they are subjected to

an elaborate cleansing process They are then assorted according to colour into black, grey, white, yellow and lilies

The bristles are then bleached by means of sulphurous acid or other agent, and sorted according to quality, length and size For this purpose a bunch having all the large ends pointing the same way is taken in the hand and dragged through a comb which catches and removes the coarsest ones There is a series of such combs having finer and finer teeth formed of needles of various sizes, through all of which the operation is performed. They are assorted according to size by employing at first the largest comb and then in succession the smaller ones, fixed to a work table This combing makes the bristles more elastic, and polishes them. Great care must be taken to adequately disinfect the bristles intended for tooth brushes.

CLASSIFICATION OF BRUSHES

A scientific classification of brushes and brooms is as follows —

(1) *Simple brushes* are those that consist of a single tuft of hairs either large or small.

These may again be subdivided into

(a) such as are inserted in a handle, or in a tube which serves to connect them with a handle, e g, the several varieties of hair pencils, or painters' tools, and,

(b) the large and coarse brushes in which the end of the handle is inserted and bound up in the midst of the tuft, e g, the large painting and dusting brushes, used by the house painters, and the much larger carpet brooms and besoms

(2) *Compound brushes* are those that have many tufts Like simple brushes these may be classed under two principal kinds according as the several tufts or knots which they consist of are inserted in a stock or handle, viz, (a) set work and (b) drawn work.

(a) In set work the tufts are set in the holes in the stock, e g, common brooms and dusters

(b) In drawn work the tufts are drawn in by wire through the holes in the stock, e g, scrubbing, shoe, clothes, tooth and nail brushes.

SIMPLE BRUSHES

The small brushes are made by inserting a tuft of the hairs with their roots bound together into a quill previously softened, which, on drying serves to hold them fast, for the larger size, a tin tube, either round or flat, is employed.

The paint brush, the simplest form of brush, is made by inserting full length bristles between two projecting prongs of the handle, and securing them by a wrapping of twine which is afterwards protected by a coating of glue mixed with red lead In other paint brushes the

bristles are surrounded by a metallic cap, tube or flattened case of tin which binds them to the handle In large paint brushes and dusters, the handle is secured by driving its smaller end foremost into the bristles, placed within an iron cup, which binds them fast

COMPOUND BRUSHES

In making compound brushes some wooden stock is bored usually in a lathe with holes varying in size, depth and direction to suit the kind of brush

SET WORK

Hair brooms, dusters, etc., are made by inserting tufts of bristles into a stock or head previously bored with holes for their reception. These are frequently bored angularly to the face, or the face itself is rounded so as to give the tufts an outward splay when inserted The tufts or knots are formed by gathering together as many bristles or hairs as may be needed and after one end has been struck even, the root ends are first dipped into melted pitch, then bound with thread, again dipped, and then set in one of the holes in the stock with a sort of twisting motion. Brushes of this description are usually made with bristles of the full length, but where stiffness is required, as in scrubbing, hair, and other similar brushes, each tuft of bristles is doubled so as to present both ends outward, these are then cut off square

and even, presenting a hard surface, especially when the doubling is made near the root ends

DRAWN WORK

In drawn work, the boring of the stock is more carefully performed, and a small hole is carried through from one extremity of each knot hole to the back of the stock

The stocks or brush boards are cut from pieces of requisite thickness, so as to get two out of each width of board The holes are drilled through a pattern board, to ensure uniformity, this is flat for a plane surface brush, but if the edge is to have oblique rows of bristles, a pattern bent to a corresponding obliquity is employed Drawing, the next step, is performed by clamping the drilled stock to a table and passing a loop of fine flexible brass wire through the first hole in the first row, inserting half as many bristles as will fill the knot hole double through the loop and smartly drawing on the wire, so as to pull the tuft into place and to force it as far as possible into the knot hole Then, bending the wire again, another loop is formed, and so on successively until a row is completed After proceeding thus from hole to hole and the tufts are cut off evenly with shears or regulated by a gauge to the length required, or, in case the bristles are short, the stock is filled previous to cutting The drawing wires are neatly covered

with veneer to strengthen and improve the brush, and prevent the wires from scratching the hand, after which the brush is finished up with a spoke shave and scraper, sand papered, and varnished In scrubbing the shoe, clothes, tooth and nail brushes the stiffness of the root end of the bristles is mostly desirable while in such as are used for painting, dusting or sweeping, the softness of the fag or taper ends, which are cut as little as possible, is preferable In the smaller kinds of drawn brushes, such as nail and tooth brushes, the holes are sunk in narrow grooves in the stock, which are after wards filled with a hard red cement. Small brushes set in bone or ivory are often drawn with silver wire which is either left visible or sunk in fine grooves which are cemented

TREPANNING BRUSHES

The best sorts of brushes are trepanned, in this process a number of holes are drilled in the bone back either transversely or longitudinally, and a number of holes are sunk through to these from the face side of the brush, the tufts are then drawn with strong thread or silk, and the longitudinal or transverse holes filled with plugs of bone or ivory

Whalebone, cut into strips, and split, is used in the same manner as bristles, to form brushes, either by itself or in conjunction with bristles

MODERN METHOD

In a modern brush making machine, a quantity of the bristles is laid upon a comb-shaped feeder, and a steel point parts from their edge, and spreads upon the apron, just enough for one bunch A plunger comes down upon this bunch and bends it double, the two halves fitting into slots in a follower in size suited to the work in hand A carrier then pushes about two inches of wire through the bunch at the bend and cuts off the part thus advanced The plunger now pushes the doubled bunch with wire down into a nut with spiral threads or rifles on the inside, at the same time giving it a twist The effect of this motion is to wrap the wire as a spiral or screw thread around the bunch, and the twisting or gimlet motion continues so as to screw the bunch, wire and all, into the hole of the brush stock below, giving it the firmness and solidity of a screw Then releasing its hold and giving one revolution back ward, to take the twist out of the bunch, the plunger flies up and is ready for another bunch, which it pre pares and inserts by the same motions This set of operations is complete at the rate of about 70 series per minute, thus finishing an ordinary scrubbing brush within that time As the holes do not pass through the wood no back is required.

ROPE MAKING.

THE raw materials employed in the manufacture of ropes, cords, and twine, are very numerous, and include hemp, flax, cotton, linen, jute, manila hemp, horse hair, wool, camel hair, and other animal fibres. Most commonly these are made of hemp, but various other vegetables are occasionally employed. The Chinese even use woody fibres, and the barks of trees furnish cordage to other nations. Coir ropes (that is ropes made of coconut fibre) are much used on board ships, since, though not so strong as ropes of hemp, they are not injured by the salt water A great modern improvement is the introduction of ropes made of wire (which may or may not be galvanised) for the standing rigging of ships and other purposes.

Ropes from Waste Materials

Inferior kinds of ropes are however made by utilising otherwise useless materials such as the tows of the various fibres, scrutching wastes, jute cuttings, old ropes, refuse fibres, gunny bags, sacking, in fact, every description of waste from fibrous materials that can be combined by the twisting process into a yarn may be employed in making ropes

MATERIALS FOR ROPE MAKING

It may be stated that generally—

(a) Superior qualities are made from the best materials, such as, the long line of the hemps and flaxes and sound cotton

(b) Medium sorts are made from jute, various coarse fibres, and the tows of hemp and flaxes

(c) Inferior qualities are made from the wastes and broken up materials

CLASSIFICATION OF ROPES

It will be useful at this stage to explain the phraseology employed in the rope industry

The word *rope* generally implies a large stout cord of hemp exceeding one inch in circumference, smaller goods are described as *cords, lines, twines, threads,* etc, and their constituents as *yarns*

A *strand,* as it is called by rope-makers, consists of a considerable number of yarns all twisted together, generally from sixteen to twenty five, a *hawser* consists of three strands, a *shroud* of four, and a *cable* of three hawsers or shrouds

Large ropes are distinguished into two main classes, the *cable laid* and *hawser laid* The former is composed of nine strands, namely three great strands, each

of these consisting of three smaller secondary strands, each formed with an equal number of primitive yarns. A cable laid rope 8 inches in circumference is made up of 333 yarns or threads, equally divided among the nine secondary strands A hawser laid rope consists of only three strands, each composed of a number of primitive yarns proportioned to the size of the rope, for example, if it be 8 inches in circumference, it may have 414 yarns equally divided among three strands. Thirty fathoms of yarn are reckoned equivalent in length to 18 fathoms of rope cable laid and to 20 fathoms hawser laid Ropes of from 1 to 2½ inches in circumference are usually hawser laid, of from 3 to 10 inches are either hawser or cable laid, above 10 inches they are always cable laid

STRENGTH OF ROPES

Rope is either *white* or *tarred,* the latter being the best if liable to exposure to wet, the former if not exposed The strength of tarred rope is, however, about three fourths that of white rope, and its loss of strength increases with time

Rope is designated by its circumference, expressed in inches, and is issued in coils of 113 fathoms each twine in skeins and spun yarn in pounds

The strength of white hempen rope may be approximately calculated according to the following rule viz.,

square the circumference, and divide by five for the number of tons dead weight that the rope will bear The strain, however, caused by a sharp jerk upon a rope is very much greater than that of the dead weight

The following table gives the strain that may be applied to a hempen rope with safety —

Circum. in inches	Strength in lbs	Circum in inches	Strength in lbs
1	200	3 5	2450
1 5	450	4	3200
2	800	4 5	4050
2 5	1250	5	5000
3	1800	5 5	6050

PRINCIPLE OF ROPE MAKING

A single thread of yarn, consisting of fibres twisted together, has a tendency to untwist itself, the external parts being strained by extension, and the internal parts by compression, so that the elasticity of all the parts resists, and tends to restore the thread to its natural state But if two such threads similarly twisted are retained in contact at a given point of the circum ference of each, this point is rendered stationary by the opposition of the equal forces acting in contrary direc tions, and becomes the centre round which both threads are carried by the forces which remain, so that they continue to twist round each other till the new combi

nation causes a tension capable of counter-balancing the remaining tension of the original threads Three, four or more threads may be united nearly in the same manner to form a strand Three of these may again be twisted into hawsers, and, so on

Mention may be made here that shroud laid cordage has the disadvantage of being hollow in the centre, or else of requiring a great change of form in the strands to fill up the vacuity, so that in undergoing this change the cordage stretches and is unequally strained. The relative position and the comparative tension of all the fibres in these complicated combinations are not very easily determined by calculation, but it is found by experience to be most advantageous for the strength of ropes to twist the strands, when they are to be compounded, in such a direction as to untwist the yarn of which they are formed, that is, to increase the twist of the strands themselves, and probably the greatest strength is obtained when the ultimate obliquity of the constituent fibres is least and the most equable

A very strong rope may also be made by twisting five or six strands round a seventh as an axis In this case the central strand or heart is found after much use, to be chafed to oakum Such ropes are, however, considered unfit for rigging, or for any use in which they are liable to be frequently bent.

THE HAND PROCESS

To make rope by hand the first step is that of spinning the yarns or threads The spinner carries a bundle of dressed hemp loosely gathered round his waist, the two ends of the bundle being in front of him. He draws out a proper number of fibres with his hand, twists them with his fingers, and fixing this twisted part to the hook of a whirl, which is driven by a wheel put in motion by an assistant. He walks backwards down the *rope walk*, the twisted parts always drawing out more fibres from the bundle round his waist He must take care that these fibres are equally supplied and that they always enter the twisted parts by their ends, and never by their middle When he reaches the end of the walk, a second spinner takes the yarn off the whirl, and gives it to another person to fix upon a reel, while he himself attaches his own hemp to the whirl hook, and proceeds down the walk in the same way as his predecessor. When the person at the reel begins to turn, the first spinner holds his yarn firmly at the end, and advances slowly up the walk while the reel is turning, keeping it equally tight till he reaches the reel, where he waits till the second spinner takes his yarn off the whirl hook, and joins it to the end of that of the first spinner, in order that it may follow it on the reel.

The next process is to lay the cordage For this purpose two or more yarns are attached at one end to a hook, the hook is then turned the contrary way from the twist of the individual yarn, and thus forms a strand, three strands, sometimes four, besides a central one, are then stretched at length, and attached at one end to three contiguous but separate hooks, but at the other end to a single hook, and the process of combining them together, which is effected by turning the single hook in a direction contrary to that of the other three, consists in so regulating the progress of the twists of the strands round their common axis, that the three strands receive separately at their opposite ends just as much twist as is taken out of them by their twisting the contrary way during combination.

IMPROVED PLAN

Detailed method of spinning on an improved plan follows

SPINNING THE YARNS

The first stage in the manufacture of ropes is *heckling* The desired quantity of hemp is weighed to the heckler, and given proportions of this are combed out at one operation This *heckle* consists of a number of steel pins vertically inserted in a board with their points upward, the fineness of these pins depending upon

the character of the work. The heckled stuff is tied separately into bundles which are then passed to the spinner for making into yarn The spinning operation is conducted in a long covered *walk* adequately furnished.

At one end of this walk is a spinning machine, consisting principally of a large wheel This wheel is made to drive a number of small pulleys each carrying a small hook on its axle which, in its turn, receives a rapid rotary motion Each pulley engages the attention of a separate spinner who fastens a bundle of dressed hemp round his body He then draws out from the front of the stuff the quantity of fibres required to form the size or thickness of the yarn desired The spinner bends these fibres in the middle and passes the bight upon the revolving hook, which instantly twists them Simultaneously he begins to walk backward down the rope walk and passes more fibres to those which are already being twined He must take care that they always enter the twisted parts by their ends and never by their middle Great care must be bestowed at this stage so that the evenness and continuity of the thread might be maintained, with his forefingers the spinner grasps the fibres as they are drawn out, pressing them firmly between his two middle fingers To guard the fingers from injury these may be covered up with woollen cloth. The driv

ing wheel continues its motion as he steps backward And at the same time to ensure the yarn being of equal thickness throughout its length, he draws out and regulates the supply of fibre with his left hand As the yarn lengthens in his hand he passes it over pegs on the wall. When the length of the yarn is completed, it is either left to await a finishing process or is wound up on a reel for subsequent operations

WARPING THE YARNS

The next stage is that of warping the yarns, or stretching them all to one length, which is about 200 fathoms in full length rope grounds, and also in putting a slight turn or twist into the yarns to make strands. Tackle boards and sledges are the only contrivances required. At one end of the long corridor a pair of stout timber pieces are driven vertically into the ground Across these, is bolted a strong board which contains three holes corresponding to the number of strands in a rope This arrangement is known as the tackle board. The sledge consists of a strongly built frame of wood, constructed so as to be easily loaded with weights according to requirement, and furnished with twisting hooks similar to those of the tackle board.

The three holes of the tackle board are in a horizontal line, and are made to receive fore lock hooks The proper number of yarns to form the strand are affixed

to these hooks while the opposite extremities are attached to corresponding fore-lock hooks in the breast board of the sledge To bring the yarn into a tense condition, the sledge is drawn back Twisting is next commenced at both the ends, the twist, of course, being in contrary directions The contraction in length which ensues drags the sledge in towards the head of the rope walk. The operation is closed when sufficient twist has been given to the strands The three strands are then attached to the middle hook of the tackle board, and each strand is laid on one of three grooves of a top (a cone shaped piece of wood) These strands are next twisted together, the top receding from the twisting hook as the rope is formed

The above process of combining three strands into a rope is known as *laying* Thus made the rope is *hawser laid* as distinguished from *shroud hawser laid* and *cable laid* It may be noted that in the hawser lay, the strands are alloted a sufficient number of threads to give the required thickness to the rope To get shroud hawser, four strands are twisted round a core-piece placed in the centre to impart greater solidity to the rope, while for making cables three ropes obtained from the first step, are twisted or laid together to constitute a cable

TARRING THE YARNS

The third process is the tarring of the yarn Sometimes the yarns are made to wind off one reel and having passed through a kettle of hot tar, are wound upon another, the superfluous tar being removed by causing the yarn to pass through a hole lined with oakum, but the ordinary method is to tar it in skeins or hanks, which are drawn by a capstan with a uniform motion through the tar kettle Great care must be taken that the tar is boiling neither too fast nor too slow Yarn for cables requires more tar than for hawser laid ropes, and for standing and running rigging it requires to be merely well covered. Tarred cordage has been found to be weaker than what is untarred when it is new, but it is not so easily injured by water

MODERN METHOD

Machinery has long been in use for making ropes by means of which they are produced with greater equality and better finish, and the long rope walk dispensed with.

The following are the improved principles of rope manufacture with a modern machine —

1 To keep the yarns separate from each other and to draw them from bobbins revolving upon skewers

so as to maintain the twist while the strand or primary cord is forming

2 To pass them through a register, which divides them by circular shell of holes, the number in each con cave shell being conformable to the distance from the centre of the strand and the angle which the yarns make with a line parallel to it, and which gives them a proper position to enter

3 To employ a tube for compressing the strand and preserving the cylindrical figure of its surface

4 To use a gauge for determining the angle which the yarns in the outside shell make with a line parallel to the centre of the strand when registering, because according to the angle made by the yarns in this shell the relative length of all the yarns in the strand will be determined

5 To harden up the strand, and thereby increase the angle in the outside shell, which compensates for the stretching of the yarns and the compression of the strand.

In another type of machines the strands receive that degree of twist only which is necessary, and are laid at any angle with the greatest regularity, the pressure being so regulated as to give the desired elasticity, and all part of the rope are made to bear equally

COIR AND COIR ROPES.

AT the present time India occupies a most favoured position in the world's trade in coir Coir made in the Malabar Coast where the industry flourishes most carries off the palm in the world's trade so far as superiority of the fibre is concerned.

Coir is derived from the husk of the coconut. Locality, soil, climate and proximity to sea all exercise a considerable influence over the quality of the fibre The collection of the fruit at the exact time of fibre maturity, the age at which the nut is collected and husked, and the method of preparation are also important factors to be taken into consideration for the preparation of fibres with the purest hue and texture Old nuts would only yield the commoner and coarser fibres while new ones would produce the lighter qualities.

Uses of Coirs

Varied are the uses to which the fibre is put in meeting our daily wants It is greatly prized in making household articles due to its length, elasticity and springiness. It is eminently suited where lightness, cleanliness and great indestructibility are requisite. One of the main properties of the fibre is that it will stand

water, i e, it is almost impervious to wind and wave, damp and rain Coir mats and mattings, cordages and ropes bag for seed crushers are amongst the many forms of manufactured coir The fibre is also held in high esteem for certain purposes such as tow ropes, on ac count of its strength, lightness and elasticity The coir is also largely used in the stuffing of mattresses, cushions, etc. and in upholstery Coir has also found its utility in the manufacture of carpets and rugs of the strongest quality, durability and appearance

Manufacture of coir will thus present bright openings to our young men Mats and mattresses, floor mats, and door mats may also be treated as important lines of manufacture We therefore cull the following broad points of manufacture from a Bulletin published by Industries Department Madras

MANUFACTURE OF COIR

Coir is made by separating the fibre in the husks of coconuts from the pith which clings to it For this, two processes are necessary

(a) the husks must be steeped in water to soften the pith, and (b) the pith must then be beaten with mallet to loosen it from the fibre

The longer the husks are soaked, the less beating they require Accordingly there are two ways of pre

paring coir, the better one relies on softening the pith in water for so long a time that little beating is neces sary afterwards while the other aims rather at beating the pith loose after very little soaking in water The former produces *soaked* coir and the latter *unsoaked*

SOAKED COIR.

Soaked coir is prepared as follows —The husks when removed from the nuts are buried in pits dug on the banks of canals (*khals*) The pits are filled up with husks which should then be covered with coconut leaves and weighed down with big stones to keep them from rising up when they swell in the water, then the water is let into the pits. Or, they may be put into large baskets floating in a *khal* or into cages made at the side of a *khal* Whether they are kept in pits or in baskets or in cages, they should be left to soak for at least seven months, and may be left up to 12 months or even 18 But if they soak too long, the fibre becomes weak and its price is less if they soak for too short a time, it is not easy to separate the pith from the fibre

The best fibre is made by soaking the husks in *khals* in which the rise and fall of the tide are great and where the water is brackish it is an advantage also if the water carries clay in it. The tides wash away the foul gases which spoil the colour of the fibre, the salt

in the water prevents fermentation which may weaken the fibre and the clay makes the water soft and so helps to rot the pith quickly It is possible to soak the husks in pools of fresh water but the coir thus made is not so strong or of so good a colour

When the husks are soaked for seven months or more, their hard outer skins become soft and are easily removed, moreover the fibre may be separated from the pith without very much beating

UNSOAKED COIR.

Unsoaked coir takes less time to make but needs harder work. The husks may be used as soon as the nuts have been extracted or they may be kept for six months first, if they are kept they should be stored in a dry place It is first necessary to loosen the hard outer skin from the husks by beating them with heavy wooden mallets on blocks of wood, the skin is then torn off and thrown away

The work is easier if the husks are beaten under an ordinary paddy husking machine (*dhenki*), but the hammer of the *dhenki* has to be shortened and a heavy block of wood placed beneath it A woman can work the *dhenki* and a boy sits at the side holding the husk beneath the hammer and turning it so as to get the best effect from the blow

The skin comes away easily from the middle of the husks, but with some difficulty from the end where the fibres are closest It is therefore quickest to beat the ends first, four or five blows on each end should suffice. The husk should not be kept flat on the block of wood throughout, but after the first blow should be lifted at one end so that the fibres at the other spread out under the mallet and then turned over on its side When the fibres at each end have been loosened, two blows on the middle of the husk will enable the skin to be peeled off easily Care could be taken not to pull off fibres with the skin

The pieces of husks are next tied together in bundles and placed in water to soak, usually for three days, but one day may suffice in the rainy season. After this the husks are taken out of the water and again beaten to remove the pith from the fibre

The water in which the husks are soaked may be either fresh water in pools or the water in *khals*, fresh or brackish. The water of *khals* is the better Husks should not be soaked in tanks from which people take water for drinking It is an advantage to prepare coir on the bank of a *khal* for it is cheaper to bring husks to a place in boats than to have them carried in carts or on the heads of coolies.

PREPARATION OF THE FIBRE

Whichever method be used, the husks, having been taken out of the water, are beaten by men or women with wooden mallets on blocks of wood for so long as is necessary to loosen the fibre from the pith

When this has been done, the fibre should be shaken out, washed thoroughly and allowed to dry It is best to remove from the other fibres the "Brush fibre," that is, the long, thick and harsh fibres which lie close to the skin of the husk The brush fibre is used for making brush or mats for which the long fibres are not well suited, and if the spinning is to be done by a machine the mingling of stiff brush fibre with the long fibre makes the work difficult None the less, the two classes of fibre are often left together and fairly satisfactory mats and cords can thus be made

The fibre, when dry, should be loosened up and down on the ends of two sticks to remove all dirt and any pith that may still remain The cleaner the fibre, the higher the price it will fetch

The cleaning and separation of the fibres can be done more easily by hand but this is slow

YARN

After this the fibre can be made into yarn either on special *charkas* or by hand When this is done by

hand, the fibre is first rolled between the hands, or on a mat, into lengths of one foot When a sufficient number of these lengths has been prepared, two of them are twisted together in the direction opposite to that in which they were twisted first, and other lengths are added as required The yarn should be made into lengths of 120 feet

PROSPECTS

Soaked coir is the better it is of a light colour, quite free from pith and stronger, all these qualities affect the price The disadvantage is that since the husks *must be soaked for months, no return for* the money spent on them can be obtained for a long time Unsoaked coir is of not so good a colour, is never so free from pith and is not so strong, the price obtained for it is therefore less, and since more beating is necessary to prepare it, the cost of labour is greater If the manufacture of coir is undertaken anew, people are not likely to be persuaded in the first place to spend money on husks only to leave them to soak for months before they start manufacture, they will wish to see immediate results while they still retain their first enthusiasm For this reason it is better to attempt to introduce the making of unsoaked coir to begin with Afterwards when they see that its *manufacture is profitable*, people

will doubtless need no great persuasion to undertake the more profitable manufacture of soaked coir also This is the more probable, since coconut husks are not equally cheap at all periods of the year, and if a man buys sufficient nuts at the cheap season to last him during the months when the husks are expensive, it will be to his advantage to keep them soaked in water rather than go to the expense of building a shed in which they may be kept dry

HAT MANUFACTURE.

THE use of hats as a head-dress is almost universal all over the world, and there is a rising demand for these in India also Manufacture of hats will thus provide a lucrative industry to our young industrialists who would like to take up some new line in the industrial field

All sorts of materials have been used in the manufacture of hats, which are again of various forms They may, however, be divided into two great classes, viz, those felted, or made of fur, wool, silk, etc. and those made of pith, straw, etc. Both pith and felted hats are much in vogue in India as they are sun-proof and can greatly resist the inclemencies of weather Sometimes these are specially trimmed with waterproof cloths for use by out-door workers during the rainy season.

Mention may be made here that hats are different from caps and other sorts of head-dress much in use among Indians. The feature which distinguishes the hat from the Indian head-dress is the possession of a brim

Sola Hats

Sola pith is available abundantly and can profitably be made into hats The manufacture of this product

teems with great possibilities These are manufactured to some extent by indigenous workers but the demand still remains unsatisfied, thus leaving openings to others who are interested in the line

Sola pith is a floating bush with sensitive leaves, found on land annually inundated or within the margins of tanks or lakes throughout Bengal and the greater part of Assam It is also met with in Burma and South India Pith is obtained from the the ripe shoots of the plants which usually grow in 2 to 6 feet of water The thicker portions of the stems only are cut in lengths of 2 to 3 feet These are tied into bundles and stored until dry, when the brown bark is removed and the pith cut up as required For the manufacture of hats and caps or frames of *puggrees* the pith is split into thin sheets For this purpose the stem is held in front of the operator and with a long thin, sharp knife is stripped spirally, the knife being made to travel round and round within the thickness until the whole stem is reduced to a sheet not much thicker than note paper Only the best piths should be employed Hats are then worked up on wooden or clay moulds and are built up of layers of sola sheets pasted one on the top of the other For cheapness a large proportion of paper is sometimes intermixed with the pith, thus adding greatly to the weight of the hat and lessening very materially

its insulating power (to the rays of the sun) wherein lies the superiority of the pith hats (*sola topis*) over all others used in this country

STRAW HATS

Straw hats are made of straws of wheat, rye, oat, barley, etc Leaves of the palms and the *pandanus* (the screw pine, *keura, kenda*) may also be used in the making of hats

For making straw hats, only the best straws should be used These should be sorted according to their length, colour and thickness Some straws are plaited whole, being merely pressed flat to facilitate the working Others are split into four, six or eight strips This splitting is effected in a curious way A wire having four, six or eight sharp edges is thrust up the hollow of the straw so dexterously as to effect the splitting, the strips being equal in width and smooth of edge These slips when softened in water, can be plaited as easily as whole straws. The straws—as many of them as are to make one width of plait—are fastened at one end, and rapidly plaited one over another diagonally, the nimble fingers of the workers turning them over from right to left and left to right. The kinds of plait are indefinitely numerous, depending on the kind of straw, on its thickness, on its being whole or split, on the number of straws

plaited together, and on the kind of pattern produced by the mode of plaiting

PANDANUS HATS

To make hats from the leaves of *pandanus*, these are gathered before they unfold, the ribs and the coarser veins removed and the rest without being separated from the core of the leaf, is reduced to shreds After having been put in the sun for a day and tied into a knot, the straw is immersed in boiling water until it becomes white It is then hung in a shady place, and subsequently bleached for two or three days, after which the straw is ready for use

The plaiting of the straw commences at the crown and finishes at the brim. The hats are made on a block placed on the knees and require to be constantly pressed with the breast

FELT HATS

Felt hats are largely in demand and in fact they command the Indian markets These, as their names signify, are primarily made of felt which is made of wool and hair without spinning or weaving but by causing the fibres to get interlaced and matted into a stiff compact body by combined action of friction and moisture upon wool

Wool for this purpose should be sound and clean This may be either washed or unwashed but on no

grounds should dirty and broken wool be employed. Sometimes different kinds of wool may be mixed together to get better effects When required several wools are mixed unwashed.

Felt hats are divided into many different grades, according as they are made of fur, the lower grades of wool, or of a mixture of both materials

HOW FELT IS MADE.

To form the felt body of the hat, the wool and fur are separately bowed in the manner employed for freeing cotton from its seeds The two substances are next bowed together until they are intimately mixed, after which the mass is spread evenly, covered with an oil-cloth, and pressed to the state of an imperfectly tangled felt. The next process is to cover the felt with a triangular piece of damp brown paper, and then to fold it in a damp cloth and work it well with the hand, pressing and bending, rolling and unrolling it, until the interlacing or felting is much more perfect, and the mass is compact

PRINCIPLE OF HAT MANUFACTURE BY HAND PROCESS

The felt thus prepared is next to be hardened For this purpose it is taken to the wide brim of a boiler charged with hot water and beer grounds and a small quantity of sulphuric acid, it is wetted, rubbed, and rolled, until it no longer contracts. The felt is next

stiffened with shellac, a solution of which is applied by means of a brush to one or to both sides of the felt, after which it is heated in a stove, and by this means the whole substance becomes duly impregnated with the resin, this renders the hat nearly water proof

To form the nap of a hat, one half or three fourths of an ounce of some less costly fur are bowed together and imperfectly felted in the manner already described, and shaped the same as the body to which it is to be applied, that body is then softened by immersing it in the boiler, when the nap is applied and worked as in felting, until the required union is effected between the two bodies

The felt thus covered is brought to the proper shape by working it on a wooden block, and is then dyed black The hat is softened by steam, the crown is strengthened by placing in it a disc of scale board, and linen is pasted over this. The nap is raised, and a uniform direction given to its fibres by means of warm irons and hair brushes The last processes are binding and lining, when the hat is ready to be worn In the low priced hats of the present day, commoner wool and fur, and smaller quantities of each are used

BEAVER HATS

Beaver hats of the finest qualities are made with lamb's wool and rabbit's fur The mode of manufac

ture is as detailed above, use being made of beaver fur in the formation of the nap of the hat

THE MODERN PROCESS

Felt hats are manufactured on a large scale in foreign countries Machines are used to get better results and finish The modern principle of manufac ture is given below —

CLEANING AND WASHING WOOL

The wools and hairs to be made into felt for the hats are mixed, and then the mass is carefully bowed to open the fibres When working on a big scale, machines may be used for saving labour On this occasion a machine, technically known as *opener*, may be employed This will open the fibres of the wool and eject all loose sand and dirt Too much wool must not be fed into the machine at a time, for then the machine will fail to work and will be chocked

To develop the felting qualities, the wool is next to be washed in caustic soda and soap sud For this purpose, get caustic soda and soap dissolved in two separate vats, using 1½ lb of either to every gallon of hot water A pan is then charged with the two solu tions Now place a thin layer of wool upon the travel ling brat in front of the washing machine and have it passed through the bath Next, pass the washed wool

again through a warm water bath to which a little soap has been added

CARDING WOOL

The wool thus washed is allowed to dry until it contains only very little moisture and is opened by an opener The wool is then ready for carding To this end, single carding machine may be used for breaking up the wool. The carded wool is then taken to a second carding engine The wool is so adjusted at the back of the carding machine by two wooden guides, as to bring a web nearly one foot in width A very steady feed is requisite to make a good even form free from the knots, which are produced by bad carding

THE HAT BODY

The wool is taken by the attendant as it comes from the carding engine and is guided by hand into a hat forming machine where the form of the hat is completed The machine essentially consists of a cone which is of suitable shape and size and is made of tin or wood and serves as a hat body This is placed in front of the engine and at right angles to it

By a peculiar action of the machine, the wool is lapped upon the two ends of the cone alternately It is run in the centre to make the brim of the hat For hard hats the brims are formed very thick with a very

thin *tip*, while for soft hats the forms are wound on about even in thickness

HARDENING THE HATS

The formed hat is next taken to the hardening machine It is moistened by steam and then the pressure is applied and suitably regulated either by the steam or the length of travel of the cover or the pressure. Before passing on, all the thin places in the hat should be discovered by holding it against proper light. Correct these defective spots by putting thin layers of wool over them. This will make up the felt to an even thickness.

After carefully stopping up any thin places, cut a piece of linen cloth of the same shape as the inside of the hat form, steep it in water, wring it, and by inserting it between the folds, prevent the hood from falling fast together

Immediately the wool is settled by steam and pressure, harden and open out the hood and remove the linen cloth. Scrutinise the hood again and repair any defective part, if discovered.

Next fold it so as to bring into the middle the two sides or edges that received no pressure and again place in the machine

By this time the sides all round ought to have been transformed from a thick flossy wool to a loose thin cloth The crown or tip has been first solidified, by the latter process the form is completely hardened and ready for the next process, planking

PLANKING THE HATS

Having made the felt firm enough to stand the pressure of a machine, take the wool bodies to the planking shop Here are machines specially adapted to reduce them to about one third their original dimensions This machine consists of a lead lined cistern charged with a mixture of hot water and sulphuric acid. Take 8 or 12 hats, dip them in this and then roll them in an India rubber cloth about 30 inches long

After working for some time, remove the hats from the cloth, open out and fold so as to bring the edges to the middle, hastily run them again through the machine

Those woollen hats which do not adhere under pressure are next deposited 4 or 5 gross at a time in the fulling stocks This consists of a chest which is constantly fed with sulphuric acid and warm water The hats remain here until the beating action of the stocks overhead has milled them up to the right size.

WASHING AND DRYING THE HATS

After the hats have undergone the above processes, wash out the goods in clean water and then pass between a pair of wringing rollers to get rid of superfluous acid. The hats are thus partially cleansed. Next dry them on a stove fitted with racks on every side even in the centre

STIFFENING PROCESS

After the stoving process is finished the hats are subjected to a stiffening process Carefully examine each hood again and rectify the defective ones, if there be any

A varnish made by dissolving shellac, mastic, sandarac, and other resins in alcohol or the naphtha of wood vinegar, is generally employed as the stiffening and water proof ingredients of hat bodies A solution of caoutchouc is often applied to horse hair hat bodies The usual quantities are 4 lbs of shellac to 1 gallon of spirit. These are macerated in the cold, and stirred from time to time until all the solid lac has dissolved The solution is diluted with more spirit as required, but the amount necessary is a matter of experience The stiffening is applied with a stiff brush, the quantity used varying with the stiffness required. The hats are then placed upon blocks in wooden chests and carefully

steamed for 20 minutes to remove the stiffness of the surface and dried.

For ensuring better results a number of large tubs and several dipping vats are required There is a steam chest for reducing the "proof," as the sizing *mixture is called.*

Those of the ordinary woollen hats which are intended to be black are stiffened with a mixture known as a "water proof," the ingredients being 1 part of soda, 3 or borax, 6 of gum thus, 8 of rosin and 30 of shellac, all by weight To prepare the mixture, follow the direction given below Turn the steam into the proof pan Dissolve the borax in warm water in the steam pan, and then add the rosin, thus and soda When these are dissolved, add the shellac. Stir, constantly all the while

The wool bodies brought from the stove room should be thoroughly cooled before being subjected to the proof The "dip" is then reduced to the right consistency in suitable vessels The hats are then dipped in the proof deep enough to include the entire brim They are drawn out, stoved and immersed again for crown proof, any superfluous proof being of course removed They are next laid on the floor to set hard and subjected to other minor operations when they are ready for the steaming chest. Here the stiffening fluid

is cleaned from both the inside and outside. After the stoving has been done thoroughly the goods are taken to the dye-house.

DYEING HATS.

For the large part hats are dyed black. Great precautions are necessary so as not to injure the fibres.

The dye pan is of stout copper while the dye is made by extracting logwood in a warm bath. The liquor is well stirred and the goods are then immersed. It is necessary to keep the pan at a regular heat. Turn the goods thoroughly while in the pan. Remove after one hour and expose to the air The black will deepen by atmospheric action. The process is repeated twice or thrice.

The goods are next removed and washed in clean water. They are now ready for Blocking.

BLOCKING AND PRESSING

Here the goods receive shape at the hands of the blocker. Buckets containing cold water are slowly heated by steam and with its help the hat is fitted on to a block of the shape and size required in the finished hat. To make the felt more pliant and elastic, a little meal may be mixed with water

The blocked hats are next passed on to the stove department where they are gently dried. Great care

should be taken at this stage to see that the hats retain their shape, the temperature being regulated to suit the amount of moisture present After the hoods are dried, the hard hats are strengthened by passing a brush with a little more proof

The hard hats are next subjected to the process of pressing The hats are removed by opening the press and if found satisfactory passed on to the finisher

FINISHING THE HATS

Some finishing lathes are necessary for general work while the undersides of the brims are finished with the help of iron plates to suit half the size of a hat While the hat is turned on the lathe it is also sand papered at the same time The hat is then brushed with a stout brush and the sand paper again applied gently on the upper side of the brim and crown, and so on till the whole surface is finished Thus a fine surface will be produced

SHAPING THE HATS

The hard hats coming from the hand of the finisher pass to the shaping department, to receive various treatments, according to the style of curl required in the brim. They are curled, shaped and trimmed as much as desired

VELURING THE HATS

The last process is that of "Veluring" for laying the fibres and producing a fine finish This is effected by means of Veluring lathes The dirt is brushed from the hat, and with a dampened velvet pad a hot ironing is applied to impart polish and even surface

SILK HAT

Silk hats consist of a cover of exterior part made of silk plush, which is laid upon a stiff but unfelted foundation This foundation, according to the strength or the price intended, is made of calico, linen, cambric, or other textile material, stiffened with shellac and various other gums, and brought into shape by being worked over and around a block The covering is a silk plush, woven with a kind of long velvet nap or pile on one surface The covering of the foundation with this plush is a work requiring much nicety,—to cut the plush so as not to make much waste, to sew the pieces together after being cut, to give the foundation a coating of gum or cement, to fit the plush neatly on it, to cause the two to adhere by plush carefully around the rim, to brush and smooth the surface in such a way that the seams in the plush shall not be visible The so-called velvet hats and satin hats deserve those titles only so far as the plush resembles those materials.

CIGAR MAKING.

TOBACCO in considerable quantity is grown every year in India, but except for the purpose of making *hookah* tobacco for which there is considerable demand in the country, no large use is made of the indigenous *stuff for the manufacture of cigars, biris and cigarettes.* It is time that due attention to this aspect is paid by our industrialists The huge quantity of unmanufactured tobacco annually exported from India proves the abun dance of raw materials for the purpose, and the equally big quantity of manufactured tobacco imported into India indicates a good market for the finished product

The tobacco used in the manufacture of cigars, etc is classified as fillers, wrappers and mixtures Sumatra tobacco is considered to be unrivalled for the manufacture of external wrappers of cigars, while Vuelta Abajo leaves of Cuba furnish the best fillers which go to make the body of the cigar Again Turkish, Havana and Virginian tobacco are also used to give the finest flavour

Indian Tobacco Leaves

Indian tobacco is generally of poorer quality but the average quality has now much improved due to

careful methods of cultivation and curing The Sumatra tobacco acclimatized in the agricultural farms has already established a reputation as a cigar wrapper American varieties of tobaccos, Adcock, Burley, etc., are being successfully grown in Bihar, N W F Provinces Golden leaf from Guntur is found good for cigarette making and *Thindoor* and *Sindine* from Burma for *cheroot* wrappers and fillers But as a general rule the indigenous varieties like Matihari, Rangpur, Nepani, etc., yield products which are good enough for *hookahs* and *biris* but are not suitable for the manufacture of cigarettes which have come much into vogue in recent years. This shows that though at this stage cigarette making seems to be outside the pail of practical politics, cigar making and *biri* making may be taken up on a large scale, and as a matter of fact these industries thrive well in many parts of India.

CHARACTERISTICS OF TOBACCO

The principal characteristics of tobacco for cigars may here be noted. One of the most important characteristics is flavour Finest tobacco must possess sweet and pleasant flavour This must be neither too mild nor too strong The filler in cigars, etc., should have this property Cuban and American tobacco are usually used for this purpose. Sumatra seed leaf has proved to

a certain extent successful in Bengal On the other hand it is desirable that wrapper leaves should be as free from flavour as possible, since it comes into actual contact with the lips and tongue of the smoker but it must possess a light and uniform colour, be thin and elastic in texture and the veins of the leaves must be small and comparatively inconspicuous The burning quality of tobacco is also of great importance It must burn readily and yet evenly, quietly and completely so that no half burnt char is left The colour of the leaf should be neither too pale nor too green Sumatra leaf as grown in Rangpur possesses these characteristics satisfactorily

COMPOSITION OF CIGARS

Cigars consist of certain portions of small and broken leaf tobacco rolled together in the form of a short stick or rod tapering to a point at one end called the curb or twist, and firmly wrapped round with one or two wrappings of whole leaf tobacco *Cheroots* differ only in form from ordinary cigars, sloping gradually from the thick to the thin end, which instead of finishing at a point, is cut and trimmed the same as the thick end

Cigars are thus composed of two parts, a core formed of pieces of leaf placed longitudinally, known as "fillers" and a covering formed of a perfect leaf, called

the "wrapper" Fillers are again kept in shape by "binders" Only through long experience, vast knowledge and varied taste is the successful selection of the qualities of leaf for the different parts of the cigar possible Where best leaves are not available, the leaves are often treated with special preparations to improve their quality, to hide their inferiorities, and lastly to suit certain taste by judicious blending of leaves

PRELIMINARY PROCESSES

To this end, the leaves are allowed to undergo certain preliminary processes before they can be used by the cigar roller The leaves must be properly cured, stalked or stripped of the mid ribs, damped and flavoured before use The detailed process follows but mention must be made here that leaves are cured before being sold in the market by the growers themselves and those cured with light brown colours are considered best for cigar making

DAMPING

After the tobacco leaves are received from the cultivator, the first process they undergo is "damping' This is necessary to overcome their brittleness so that they may be worked without breaking After separating the bunches, the leaves are scattered loosely upon the floor They are then watered through a fine hose The

quantity of water depends upon several factors such as the absorbing power of the leaves They are left for a day or so Sometimes instead of water, preparations of salt, sal ammoniac, *gur* and sugar are used for damping

STRIPPING

To strip is to deprive the leaf tobacco of its stem and midrib After being damped the leaves are passed on to strippers They fold each leaf edge to edge and rip out the midrib and remove the stem. The workers classify the two halves of each leaf and range the sorts in separate piles as smooth as possible

SORTING

They are then assorted with much dexterity The leaves are generally sorted into three grades according to their length and strength (1) Wrappers, (2) Binders, and (3) Fillers.

The largest and the strongest leaves are selected for "wrappers." These must be perfect, silky in texture, elastic with regular veins and fine grains Leaves containing slight flaws are set apart for "binders" The best portions of the leaves meant for "fillers" may also be used as "binders," while the broken and defective pieces are utilised as "fillers" for cigars

FLAVOURING.

Fillers for cheap cigarettes are sharply flavoured to improve their taste The liquids usually employed for the purpose are rum and water, sour wines, vinegar, etc. The various combinations of the so-called "Box scent" are trade secrets The articles entering into its composition are liquorice, rum, lemon, cedar, vanilla bean, oils of spices, etc

The various tinctures such as those of cascarilla, vanilla, valerian, tonka bean, etc, are usually employed for flavouring tobacco for cigars. Havana stems mixed in alcohol and water with orris root may also be used.

The tinctures before use are diluted with a mixture of water and alcohol in suitable proportions as demanded by taste Apply the liquid with a spray On an average five lbs of tobacco will require 1 oz. of the tincture

Tobacco may also be flavoured by means of a mixture of one part each of lemon peel, orange peel, figs, coriander seed, and sassafras, one half part each of elder flowers, elder berries, and cinnamon, two parts of saltpetre, three of salt, and four of sugar This mixture must be digested in fifty parts of water, and, before applying it, flavoured with an alcoholic solution of gum benzoin, mastic and myrrh To derive the best results

the leaves must be well dried, about a year old, well permeated with the preparation, kept in a pile for eight days, turned daily, and finally dried

A few practical recipes follow —

1 Macerate 2 ounces of cinnamon and 4 ounces of tonka beans, ground fine, in 1 quart of rum

2 Moisten ordinary cigars with a strong tincture of cascarilla, to which a little gum benzoin and storax may be added Some persons add a small quantity of camphor or oil of cloves or cassia

3 Tincture of valerian, 4 drachms, Butyric alde hyde, 4 drachms, Nitrous ether, 1 drachm, Tincture vanilla 2 drachms, Alcohol, 5 ounces, water enough to make 16 ounces

CIGAR SPOTS

The speckled appearance of certain wrappers is due to the work of a species of fungus that attacks the grow ing tobacco This may be obtained artificially by using solution composed of

Sodium carbonate	3 parts
Chlorinated lime	1 part
Hot water	8 parts.

Dissolve the washing soda in the hot water, add the chlorinated lime, and heat the mixture to a boiling

temperature for 3 minutes When cool, decant into earthenware or stoneware jugs, cork tightly, and keep in a cool place The corks of jugs not intended for immediate use should be covered with a piece of bladder or strong parchment paper, and tightly tied down to prevent the escape of gas, and consequent weakening of the bleaching power of the fluid. The prepared liquor is sprinkled on the tobacco, the latter being then exposed to light and air, when, it is said, the disagreeable odour produced soon disappears

WEIGHTS AND SIZES OF CIGARS

It may be mentioned here that the cigars are generally made of three classes, the size and quality differing in each case The average weights of the finished cigars per 100 are as follows —

No 1	12 1/3 chattaks
No 2	10 2/3 chattaks
No 3	7 1/2 chattaks

The sizes of cigar vary from 3½ inches to 7½ inches in length, and the type, of which there are many, depends upon the length, thickness and contour of the cigar The quantity of sorted tobacco required per 1,000 of No 1 cigars is approximately nine seers of fillers and two seers of wrappers, and for other qualities proportionately less, and considering that 25 per cent

of the leaves is rejected as mid ribs and only 75 per cent is available for cigar making, the quantity of leaves, required for making 1,000 No 1 cigars is 11 X 4/3 or 14 2/3 seers

FIRST STAGES IN MANUFACTURE

Cigars are mostly made by hand. The following are the only tools needed

1 A sharp knife with a short blade

2 Cutting board (a wooden dias will suffice)

3 Emulsion of gum.

The tobacco leaves as received from the market are generally only imperfectly cured These are therefore to be cured before use These are however sorted into three grades before curing

To cure the leaves, they are then dipped in a solution of sugar or *gur*, as the case may be, drained and left overnight, wrapped in gunny In the morning the leaves are unpacked on a wooden platform The mid ribs of the leaves are to be deftly taken out Boys are generally entrusted with the work and freely use their toes during the stripping operation The half leaves of tobacco thus obtained are again sorted for purposes of being used as wrappers or binders according to the condition of the leaves. The perfect leaves suitable for being used as wrappers are then tightly rolled into

bundles to smooth the leaves out The bundles are then passed over to the cigar roller The leaves for fillers may also be flavoured as directed, if so desired.

THE PROCESS

As a first step in the manufacture, an operative takes as much of filler leaves as is required to form the inside of the cigar, lays them longitudinally in the binder and binds them up into a rough cigar The fillers must be well packed and distributed uniformly and longitudinally, otherwise the cigars will neither burn steadily nor the smoke can be freely drawn from end to end The core is then kept beside the cigar roller

According to a bulletin published by the Department of Industries, Bengal, which we are indebted to for the process of work, the cigar roller has thus supplies of bundles of wrappers on the one hand and the cigar cores on the other His first step should be to unwrap the bundle, select a perfect leaf from it for wrapper and deftly cut it into shape so as to enclose the core completely The leaves are laid flat upon the cutting board which is nothing but a low table about 9 inches in height placed in front of each cutter The leaves are then cut into sizes according to requirements with the help of the sharp knife Strong galvanised tin sheets bent in the form of a semi-circle with sharp circular edges may be used as knives. The blade of the

knife may thus be employed in rolling the cigars to give them a uniform shape The topmost part which is a diameter is often ribbed for easy handling The shape of the leaves must be like that of the ordinary *biri* leaves cut and shaped for *biri* manufacture

Wrappers being cut the operators pick up the roughly formed filler, rolls it round in his palms into what is called the *bunch* till it forms the shape of the type of the cigar to be produced, and then commences to put on the wrapper In putting on the wrapper he starts at the lighting end of the cigar and finishes at the end which is put into the mouth and is called the *head*

To secure the loose end of the wrapper a small quantity of paste is generally used Ordinary flour paste will do for the purpose The *head* of the cigar is carefully fastened with the paste The cigars are next placed alongside a gauge and trimmed off neatly at the smoking end to the length required

It should be borne in mind that a good cigar when properly made should be smooth and even without any cracks It must feel firm when squeezed or otherwise it would become spongy when half smoked

SEASONING OF CIGARS

The seasoning of the cigars is an important operation The quality of the cigar depends very much on

proper ageing and unless the cigars are stored under dry conditions for about six months they do not become fit for smoking

For this purpose the cigars when completed are sorted out according to size, and quality, and made into bundles containing 25 each and packed into standard boxes of 50 or 100 They are then kept in a suitable ageing store kept at a temperature of about 100° Fahr by means of a slow fire with grate outside the building and with brick flue and chimney built up in the centre of the store Heating will be necessary during the damp rainy season only

KEEPING CIGARS

Cigars are influenced by the slightest taint there may be in the atmosphere It is a comparatively simple matter to take good care of cigars All that is necessary is to keep them in a comparatively air tight, zinc lined chest in places where the temperature is even.

It may be said that it is only the higher priced cigars that need special care in handling, although the cheaper grades are not to be handled carelessly

BIRI MAKING.

BIRI making is a small industry which is carried on almost everywhere by common people The raw materials are abundantly available The art is not difficult to master as the procedure is not complicated. One can easily learn to make *biris* simply by observing the manufacturers for a couple of hours The implements required are a pair of scissors, some thread preferably dyed, a wooden box with a bottom of wire gauze, a furnace burning charcoal or coal, bamboo trays, etc The ingredients are tobacco mixture and wrapping tobacco, the former is generally prepared from the *Nepani, Hindusthani* and *Gujrati* varieties with various scents while the latter is invariably furnished by *tendoo* leaves. These leaves are derived from the *tendoo* tree which grows wild in Central Provinces, United Provinces, Bihar and Orissa, etc.

The Biri Leaves

The best *biri* leaves should have smooth and soft under surfaces. Ordinarily the leaves from the Jhajha side present rough thick velvety under surface with small hairs, those from Singhbhum and Chakradharpur side are considered to be of medium quality, while the leaves

from the Nagpur side are considered to be the best for *biri* making Motihari and other tobaccos can also be used as fillers but they must be specially treated before being used as choppings Cured and mild tobacco leaves should as a general rule be used in making *biris*

THE PROCESS

The leaves are collected and sold in bundles. In making them ready, the bundles are steeped in water or boiled in the water vapour with or without odoriferous substances, strained after a time and cut to size Usually they are cut into rectangular shape between 3" × 1½" and 1½" × 1½" On an average a leaf may be cut into three pieces These serve the purpose of the wrapper As for the contents, suitable tobacco is shredded into fine chips, put inside a wrapper and rolled into a conical shape The top and bottom openings are closed by means of the finger The tips are tied with a thread and the ends are slightly singed. The *biris* are put for sale in packs of 25 each.

Biris are of two kinds, common and scented. Needless to point out that while the former are cheaper, the latter with perfumed fillers are more relished.

APPLIANCE.

The only appliance of importance required in this industry is a wooden box 2 cubits high, 2 cubits broad,

and 3 cubits long It shall have no cover either at the top or at the bottom Make another wooden frame of the same length and breadth but only half a cubit high, with a wire gauze fixed at the bottom and with a covering lid at the top

This apparatus is required to bake the *biris* after they are made For this purpose an oven with fired coal is placed inside the first box The second box is placed on the first and serves the purpose of a hot chamber The *biris* are put in this second box in bundles with the broad side downwards The lid is closed down for a while and the *biris* are ready when the ends become brownish in appearance

COMMON BIRIS

(1)

Proceed as above with choppings of *nepani* tobacco No 1

(2)

Proceed as above with choppings of *nepani* tobacco No 2

(3)

Proceed as above with choppings of *nepani* tobacco No 3

(4)

Proceed as above with choppings of *nepani* tobacco No 4

(5)

Proceed as above with choppings of *gujrati* tobacco No 1

(6)

Proceed as above with choppings of *gujrati* tobacco No 2

(7)

Proceed as above with choppings of gujrati tobacco No 3

(8)

Proceed as above with choppings of *hindusthani* tobacco No 1

(9)

Proceed as above with choppings of *hindusthani* tobacco No 2

SCENTED BIRIS

Suitable scents are added to the fillers before they are enclosed in wrappers The leaves for wrappers are sometimes soaked and flavoured in rose water to rende- them mild

(1)

Take dust of *nepani* tobacco No 1 and perfume with liquid musk

(2)

Take dust of *nepani* tobacco No 1 and perfume with otto of musk henna

(3)

Take dust of *nepani* tobacco No 1 and add as scent otto of Damascus roses

(4)

Take dust of *gujrati* tobacco No 1 and add a little otto henna

(5)

Take dust of *gujrati* tobacco No 2 and mix the residue of *keora* to scent

(6)

Take choppings of *hindusthani* tobacco No 1 and mix a little *muzma* for perfume

(7)

Take choppings of *hindusthani* tobacco No 2 and mix a little otto of *chameli*

(8)

Soak *pulopata* tobacco in water for 4 hours, throw away the water and reject the stalks and fibres of the

leaves. Then cut them into fine pieces with scissors and dry in the sun Add a little otto of *khus*

(9)

Proceeding with *hingli* tobacco as in (8), besmear it with rose water and dry Repeat for 5 or 6 times

(10)

Take *motihari* tobacco of yellow colour reject the stalk and ribs, and chop with scissors Soak them in rose water for a whole day and dry in the sun Then proceed to make *biris*

(11)

Take *pulopata* tobacco of good quality, reject the stalk and ribs, and chop to fine pieces with scissors, soak them in *keora* water for 24 hours, dry them in the sun and proceed to make *biris*

(12)

Take *hingli* tobacco of good quality, reject the stalk and the ribs, soak in otto-de-rose virgin, cut into fine chips with scissors and proceed as in (11)

(13)

Take choppings of *motihari* tobacco of good quality and yellow variety Macerate saffron with rose water, mix with the above and proceed to make *biris*

(14)

Take choppings of *hingli* tobacco and mix a bit of musk and otto of rose Now proceed to make *biris*

MANUFACTURE OF LOZENGES.

LOZENGES are much relished by the children on account of their delicious taste and flavour The demand for these food stuff is steadily growing and medicinal lozenges also are coming into popular favour Manufacture of lozenges will form one of the profitable small industries of India. There are already some small factories manufacturing the lozenges in the principal towns but there is still room for many more to enter the field without creating unnecessary competition among themselves

The capital to be invested for conducting the manufacture on a mediocre scale is not beyond the means of many young men The only machines required are a number of punching machines with various dies, and these may also be dispensed with if the capital is not forthcoming

Meaning of Lozenges

It must be mentioned at the outset that there is considerable misconception regarding the meaning of lozenges To be technically correct, lozenges are either made by compressing finely powdered sugar with gum, stearine and suitable flavour, or by mixing sugar, gum,

water and flavour into a stiff paste and then cutting into pieces of proper size These are made without the application of heat but in India the articles going by the name of lozenges are made without the addition of gum and with the aid of heat.

RAW MATERIALS

The principal ingredient in the making of lozenges is sugar, which must be double refined The other ingredients are colours and flavours, which are available ready made in the market

Vegetable colours were once in large use among the lozenge makers but these have now been replaced by cheap edible coal tar dyes which are also easy to handle

Flavours for lozenges may be those obtained direct from the fruits and drugs. But now a-days more often than not they are obtained from synthetic sources Imitation fruit essences are now made by the proportionate blending of the synthetic products, and are plentifully available in the market

THE APPLIANCES

The following are the principal appliances which a manufacturer must possess for facility of work —

(1) A furnace made of brick for the boiling of the syrup The furnace is fed with coal

(2) A number of sieves for sifting sugar

(3) A drum, made of iron or copper, for boiling the syrup The drum must be provided with a long handle which facilitates its removal from the fire

(4) A long table about 2 feet in breadth and as high as the ordinary writing tables for pouring the syrup to cool and treating the cooled mass These are topped with thick stone plates

(5) A number of heavy steel rods about one inch square in cross-section and about 2 feet long The bars may be arranged on the table to form compact rectangular compartments. The boiled syrup is poured into one of these compartments to cool It is essential that the compartments must not be very big for unless the cooled mass cannot be handled as soon as the mass cools, it will get too hard to be worked. Differently coloured syrups must be poured into different compartments. As a general rule the syrup contents of one drum should be no more than that required to fill one compartment The length of the table should depend upon the number of compartments to be made which would again depend upon the speed at which the lozenges are made

(6) Another table of the same height and breadth as that mentioned in (4) This should be about 10 to 12 feet in length so that five or six operatives can work freely side by side

(7) A number of big tables broader in size with tin plates as covers and having rims all around the sides The lozenges are to be spread on these tables to cool after these are made

(8) A number of punching machines with dies of oranges, lemon drops, fishes, etc.

(9) Knives, scissors, etc.

THE PRELIMINARY OPERATIONS

To start, it is first of all necessary to reduce double refined sugar to fine powder by pounding the sugar on a stone with a muller, it is then passed through a sieve, not too fine so that fine dust may be eliminated The use of fine dust in syrup making is to be condemned as this would destroy the beauty of the lozenges The sugar is then put into the iron or copper pan which has been properly cleaned beforehand and is moistened with water, which is to be added gradually Stir the mixture with a paddle all this time and when the sugar falls off from it, the sugar is considered to be sufficiently moistened and no more water should be added into the drum. The drum however should by no means be more than three-quarters filled. The pan is then put upon the furnace to boil

THE COLOUR FOR LOZENGES

In the meantime get the colours to be added ready The colours should be in accordance with the flavour to

be imitated. For example, when lemon lozenges are desired to be made, the colour and flavour should as far as possible correspond to the natural colour and flavour of the lemons

As a general rule, coaltar colours are used in the making of lozenges The colours used must be quite harmless and edible.

The colours before being added to the boiling syrup are reduced to fine powder. For, if the colour has not been properly ground, little points of very vivid colour will appear at intervals. Special care is to be taken when more than one colour is used to produce the desired colour effect In such cases due to different solubility of the component parts of the compound colour, the more easily soluble will find sufficient moisture separated by crystallisation or absorbed from the atmosphere to separate it from the remainder of the mixture, giving the lozenge a mottled appearance, blotched or streaked with blue and pink, or blue and yellow, as the case may be

LIQUID COLOUR PASTE.

The colours to be added to the syrup may be in a liquid state For ready use, the colour after being properly ground is dissolved in the smallest quantity of water or alcohol. But sometimes liquid colours can be kept ready for use for a long time. The method of

preparation in this case is as follows —1¼ oz of the powdered colour should be dissolved in the smallest quantity of water or alcohol Mix this solution into a pound of glucose and evaporate the liquid to a very thick paste Colours thus prepared have these advant ages that they mix readily with the boiled sugar, and very little is needed to colour a large portion of the dough or syrup These colours are put into separate tin boxes

ADDING THE COLOURS

The amount of the colour to be added to the syrup would depend upon the shade of colour desired.

BOILING THE SYRUP

When the syrup is just put on the fire, the colouring matter is to be added, either in the liquid state or in powder form The mixture is stirred with a little glass spatula until it becomes liquid As soon as it is about to boil, this is taken away from the fire and examined If it is found to be too moist, a little more powdered sugar is added, and the whole is stirred until it is of such a consistency as to run without spreading too much

LOZENGE DROPS

When working on a small scale, without any appliances, the syrup may be allowed to fall drop by drop on a tin plate covered with a thick layer of starch

by holding the pan in the left hand and a small rod of iron or copper in the right In two or three hours the drops become hard and brittle, and are collected and at once put into bottles or tins

POURING THE SYRUP FOR COOLING

The above method is however out of date The melted sugar is poured into a compartment made by arranging the iron bars on the stone table previously cleaned and slightly moistened with oil The syrup is allowed to cool there This should not however be allowed to be cold for then the sugar will crystallise and cannot be made into lozenges

ADDING THE FLAVOUR

The flavour is to be added at this stage A few drops of the artificial fruit essences, such as those of banana, pineapple, strawberry, etc are scattered over the mass For flavour of orange, add a few drops of oil of neroli or for lemons a pinch of citric acid The flavour is mixed intimately with the mass with the help of a big pallate knife Special attention should be paid to attain a flavour that would appeal to the taste of many, for it is almost a truism that the secret of successful sale of lozenges lies in the peculiarity of their flavour In some cases a harmonious blending of more than one flavour may be found to catch the market

MAKING LOZENGE BALLS

While still warm the whole mass is made into a number of suitable lumps and well kneaded by hand to make the colour quite uniform Each of the plastic lumps is then drawn out into a thick thread by an operator and a suitable length is cut out of this by a pair of sharp scissors The length is then made quite circular by rolling on the second stone table slightly oiled. It is then cut into small bits of uniform size with the help of a pair of sharp scissors As soon as they drop on the table in the shape of small cylinders, another operator begins to roll them on the table with the palm of the hand and transfers them to the next operator who is also entrusted with the rolling of the imperfectly rolled balls He also transfers the balls to the next man as he receives a fresh supply to be rolled, and so on The pieces generally pass from five to six hands before they can be expected to be quite spherical in shape

The first operator thus goes on with rolling out the lumps into circular threads and cutting out the rolls into small cylinders in the above manner while the balls are rolled by a band of workers all arranged in a line along the table

When the balls are thus rolled, they are allowed to cool For this purpose they are spread on the big

tables with borders all round, and there too they are rolled by hand. When cold they are passed through a sieve and bottled up

SUGAR COOLED BALLS

The lozenge balls may be further coated with fine sugar For this purpose the balls are slightly moistened by handling them with palms moistened with water or some suitable flavour diluted with water In the mean time sugar is spread on a tin plated table which can be given a rocking motion by tilting the sides up The moistened balls are poured on the layer of sugar and the rocking motion of the table causes the lozenge balls to roll on the layer of sugar and thus assimilate a coating of sugar all round The object can be more conveniently achieved by spreading the sugar in a layer on a clean piece of canvas or hessian and putting the balls to be sugar-coated well scattered on the sugar The corners of the textile can be raised up so that the balls may be easily made to roll on the layer of sugar The balls thus coated with sugar are very much relished and fetch higher prices

VARIEGATED COLOUR EFFECT

The balls of lozenges can be given a blotched or streaked colouring if desired in the following manner The melted sugar in the compartment while still warm is to be specially treated for this purpose About one

tenth of the mass is separated from the main body with the help of a knife This is then drawn out in the form of a thick thread and again mixed up The operation is repeated for a number of times when a quite distinct colour from the main body of the melted sugar will be seen to develop This is then rolled into a thick circular thread and cut into, say, six equal lengths These are then arranged laterally leaving some space between each The remaining mass of sugar is by this time flavoured, and kneaded and flattened out into a size slightly bigger than the space occupied by the six sticks of sugar This mass is put upon the six threads, and projecting portions are cut out from the sides with a knife The whole mass is given a slight pressure from the top so that the six threads of melted sugar get attached to the main body of the plastic mass The plastic mass is then taken up carefully and the formerly cut out projecting portions are put on the upper side The whole is then made into a roll with the side streaked with threads up The mass is then capable of being drawn into threads as before The rest of the process is the same as in making ball lozenges

LOZENGES WITH DESIGNS

When working on a large scale, or when lozenges of beautiful designs are wanted, special punching machines are to be taken recourse to The melted sugar

allowed to cool in the compartments is properly flavoured and made up into a number of lumps Each of the lumps are then flattened out to approximately uniform thickness, and the breadth of the sheets made out from the lumps is approximately the same as that of the punching machines which essentially consist of one set of rollers and are usually designed 3¾ inches, 7 inches and 8¼ inches in length with the design stamped or embossed on both rollers which are again interchangeable The dies with the desired design are put into operation and the warm and soft sheets are fed into the punching machines The handles are made to rotate with the hand and as the sheet passes between the rollers bearing the half models of the design, it is at once converted into a batch of symmetrical lozenges The upper and lower half of each lozenge are moulded by the corres ponding hollows of the upper and lower rollers Sheets of lozenges come out of the machine which are spread on the big tables and they are allowed to cool Cold air may be blown over them Ordinary palm leaf fans may be employed for this purpose The sheets are then slightly tapped on the table when they break up into pieces and the lozenges of perfect shape will be obtained If the pieces do not easily separate owing to the joints in the lozenge sheets being strong, the pieces are to be cut out by scissors Finally the lozenges are sifted to

remove the broken pieces and scraps, which however may be re-used.

AUTOMATIC MACHINE

A new automatic machine has been devised with a view to securing the largest output possible The machine is described by Mr Robert Whymer as follows "Six pair of drop rollers are fitted upon a strong frame which revolves so as to bring any pair opposite to the table and into a mesh with the driving gear By this arrangement when a pair of rollers becomes overheated it can instantly be replaced by partially revolving the frame to bring up another pair opposite the table The drive to the rollers is controlled by a clutch on the right hand side of the machine The sheet of the drops after passing through the rollers is delivered on to steel bands which carry it forward at the same speed as it is delivered to the rolls, thus avoiding deforming the drops by handling The sheet of the drops as it passes down the table is fanned by a strong current of air The cooled sheets are carefully broken up by a special attachment, and the sweets are automatically sifted and delivered direct into boxes placed ready to receive them."

UTILISING SCRAPS

The scraps of lozenges should not be allowed to go to waste A well-equipped factory uses up its scraps for dark coloured goods No scraps, however, should be

put into any class of hard boiled goods The scraps in many workshops are put into the next batch of boiling sugar syrup Used without reboiling, the scraps melt only imperfectly and consequently leave grains in the paste, spoiling the goods completely within a short time

TABLET LOZENGES, ETC

Mention has been made of preparations of lozenges without the aid of heat For this purpose sugar which must be double refined is pounded fine, gum, colour, and flavours are also finely ground separately and mixed up intimately In some cases no water is added and the powder is compressed into tablets with the help of tabletting machines In other cases the ingredients are made in the form of a paste with water and made out into lozenges with suitable punching machines Success in these cases would depend upon the thorough incorporation of the mass

MEDICINAL LOZENGES

Medicinal lozenges generally go by the name of Troches They are small, dry, solid masses, usually of a flattened shape, consisting for the most part of powders incorporated with sugar and mucilage They are designed to be held in the mouth and dissolved slowly in the saliva, and are, therefore adopted for the administration of those medicines only which do not require to be given

in large quantities and which are destitute of any very disagreeable flavour

They may be prepared from almost any medicine, which it is advisable to administer in this form Most medicinal lozenges are made by the pharmacopoeial process to be described below Diverse methods are however, adopted in the confectionery trade, depending upon the nature of the ingredients and whether they are combined in the cold or hot way The following process is generally adopted.

APPLIANCES FOR MEDICINAL LOZENGES

A list of appliances for making tablet and medicinal lozenges on a small scale is appended

(1) A smooth marble slab, with adjustable sides, to cut the lozenges upon

(2) A smooth stone slab to mix the paste on

(3) A rolling pin

(4) Lozenge-cutters

(5) A good pallate knife (15 ins)

(6) A brush made with long soft hairs

(7) Linen cloth to run through cutters when clogged with the paste

(8) Lozenge-trays made of light, smoothly planed seasoned wood (4 ft.×2 ft.×1 in.)

(9) A drying closet with racks fitted all round to place the trays of lozenges upon, and heated free from dust and smoke

(10) Gallipots of water, napkins, etc

HOW MEDICINAL LOZENGES ARE MADE

A mucilage of tragacanth is first prepared with cold water and strained With this the powders including sugar, are thoroughly mixed by rubbing upon a marble slab, and are thus formed into a paste, which is spread out by means of a roller upon the surface of the marble, previously powdered over with a mixture of sugar and starch The thickness of the mass is rendered uniform by a frame upon which the ends of the roller rest The upper surface is now dusted with sugar and starch, and the mass is divided into small cakes by means of a punch These cakes are placed upon paper, and having been exposed to the air for twelve hours, are carried into a drying room moderately heated When perfectly dry, they are thrown upon a sieve to separate the sugar and starch and are then enclosed in boxes

The processes for preparation of lozenges as recommended by the British Pharmacopoeia are given below:—

WITH SIMPLE BASIS

Take five hundred times the quantity of the drug ordered for one lozenge, mix it with 496 grammes of

Refined Sugar and 19 5 grammes of Gum Acacia, both in fine powder Make the mixture into a paste with 35 millilitres of Mucilage of Gum Acacia and sufficient quantity of Distilled Water, divide into 500 equal lozenges and dry in a hot air chamber at a moderate temperature

WITH FRUIT BASIS

Take five hundred times the quantity of the drug ordered for one lozenge Mix with it 6 5 grammes of Tragacanth and 26 grammes of Refined Sugar, both in powder form. Add sufficient of the Black-currant Paste of commerce to produce 650 grammes, beat into a uniform mass, divide into 500 equal lozenges and dry in a hot air chamber at a moderate temperature

WITH ROSE BASIS

Take five hundred times the quantity of the drug ordered for one lozenge Treat it as described under "Preparation with Simple Basis," previously mixing with the Refined Sugar 0 025 millilitre of Oil of Rose

WITH TOLU BASIS

Take five hundred times the quantity of the drug ordered for one lozenge, dissolve such salts of alkaloids as may be ordered in 10 millilitres of Distilled Water, mix the solution with 482 grammes of Refined Sugar

and 19 5 grammes of Gum Acacia, both in fine powder Incorporate 10 millilitres of Tincture of Balsam of Tolu and any other drugs ordered for the lozenges. Make into a paste with 35 5 millilitres of Mucilage of Gum Acacia and a sufficient quantity of Distilled Water, divide into 500 equal lozenges and dry in a hot air chamber at a moderate temperature

Any of these bases will be found suitable for the preparation of medicament lozenges

RECIPES

A few typical processes of making ordinary tablet and medicinal lozenges follow —

ACIDULATED LOZENGES

1 Take citric acid in powder, a drachm, powdered sugar, eight ounces, oil of lemon, twelve minims, mucilage of tragacanth, a sufficient quantity Form them in the usual manner into troches of twelve grains each Lozenges are some times made by saturating blank lozenges with aromatic spirits

2 Tartaric acid, ½ oz dissolved in a very little water is added to each lb of sugar, with essence of lemon or orange to flavour as desired

CHOCOLATE LOZENGES

Chocolate 1 oz is reduced to a fine powder by scraping and added to powdered white sugar, 1 lb , then

the mixture is made into lozenges as above, care being taken not to heat it for the second time

FRUIT LOZENGES

These are prepared according to the method given above, the flavouring essences, viz, Essences of lemon, orange, citron, raspberry, etc. not being added until the sugar is melted, to avoid as much as possible loss by evaporation The colouring matter may be any of the transparent stains usually employed for cakes, jellies and confectionery In this way is made the majority of the first class fruit drops

PEPPERMINT LOZENGES

Peppermint lozenges are undoubtedly the most commonly used medicinal lozenges

Take 28 lbs of icing sugar, and make a heap of it on the slab with a big hole in the centre of the heap, then pour in 4 pints of thick acacia mucilage, and on that 1 oz of peppermint oil, working the liquids well together When sufficiently mixed, stir in the sugar from all round the sides, and make the whole into a stiff paste with as much of the sugar as can be used. If it is too stiff, add more mucilage, if too sticky, more sugar The paste is now ready to be rolled out Take about 2 lbs. from the bulk and work it with the hands into a compact square piece, keeping it from sticking

to the slab by means of powdered starch Next roll out by means of powdered starch Next roll out a portion of the mass upon the slab with the sides adjusted to a height equal to the thickness of the lozenges desired Then cut out the lozenges with a punch While the mass is being rolled, sprinkle it with icing sugar, to prevent it being stuck Transfer the lozenges to a tray, expose to dry air for twelve to twenty four hours, and finally place in the drying cup-board until hard

MINERAL WATERS.

MANUFACTURE of mineral waters forms one of the most profitable small industries in towns with pretty big population. The quantity of production would depend upon the direct consumption of the local people for the waters present great difficulty in the way of being transported to any great distance

As beverages, the mineral waters have risen to great popularity They are taken as refreshing drinks or on medicinal grounds

Classification

The mineral waters may be classified under three heads —

1 Plain.

2 Saline

3 Sweet.

The chief among the *plain drinks* is the soda water which is by the by the most favourite drink and can be manufactured with small or big machines without much difficulty This is formed by supersaturating a solution of bicarbonate of soda with carbonic acid under considerable pressure

The *saline drinks* include aerated water charged with salts such that the preparation may acquire the properties of natural mineral waters swelling up from natural springs or wells The chief among them are lithia water, biaris water, potash water, radiaris water, seltzer water, vitchy water, etc.

The *sweet drinks* are syrups impregnated with carbonic acid gas and possessed of characteristic flavour, such as those of lemon, ginger, etc The most important in this group is the lemonade and gingerade.

SODA WATER.

Soda water as already mentioned is made by charg ing carbon dioxide into a solution of sodium bicarbonate in water This shows there are several distinct stages in the manufacture of soda water These are.—

(1) *Procuring of pure water and storing it in clean tanks.* Water being the chief ingredient in the prepara tion of the mineral waters for human consumption must be clear, pure and free from bacteria Rain water is the purest form of water River water may be used but the suspended impurities must be allowed to settle down before being used. Spring and well waters are on many occasions found suitable In cities and towns where there are arrangements of filtered water supply, ordinary filtered water will serve the purpose. On all occasions the chief criterion should be the purity and

the clearness of the water Great care also must be exercised in storing the water in perfectly cleaned and covered tanks and changing it daily, otherwise small worms will breed in it and render it quite useless The water should be stored in a cool place, for cool water is better aerated than warm water

(2) *Dissolving sodium bicarbonate in water* This is done in suitable vats The usual proportions are 175 grains per gallon of water

(3) *Generating carbon dioxide gas* The gas is produced by the action of sulphuric acid on marble chalk, whiting sodium carbonate, etc. Of the materials in use, sodium bicarbonate gives the purest form of gas at the cheapest rate The usual proportions are soda *bicarbonate 10 lbs*, *sulphuric acid 6 lbs* and *water 15* lbs. This would yield from $4\frac{1}{2}$ to 5 lbs of gas When whiting or marble is used about equal amounts of sulphuric acid and whiting will be required. The sul phuric acid used must be free from poisonous impurities

For the generation of the gas, use is made of closed slate, lead or lead lined cylinders provided with an acid box and an outlet for gas A thick solution is made of the sodium bicarbonate and water in this cylinder Sulphuric acid is dropped carefully through the acid box and the gas begins to issue forth at once. The addition of sulphuric acid should be so regulated that the gas is

produced in constant stream and used up in aerating the water dissolving sodium bicarbonate When the gas is no more required, addition of the acid must be stopped For ready use the gas may be stored by compressing it in iron cylinders. The small manufacturers would, however, find it convenient to purchase compressed carbon dioxide gas in cylinders

(4) *Pumping up the solution of sodium bicarbonate* into the special reservoir in the machine meant for aeration of the solution. This part is technically known as the *gasometer* This is also provided with an inlet through which carbon dioxide gas is made to enter from the gas generator

(5) *Bottling* A bottle or a number of bottles is filled with the solution of sodium bicarbonate or with aerated water leaving only a small space at the mouth The bottles are given a further charge of carbon dioxide by swinging them round Care should be taken that too high a pressure is not allowed into the bottle Great experience is required to adjust the correct pressure The correct bottling pressure for soda water has been estimated to be about 125 to 130 lbs In soda making machines there are suitable regulators attached to the gas generators to ensure a steady flow of gas at constant pressure

FILLING THE BOTTLES

Soda water is filled in bottles of special construction. Ordinarily these are 12 oz. bottles. Six ounce bottles going by the name of splits are also in use though the use is rather restricted The bottles are generally closed by glass ball stoppers with rubber bands but now a-days crown corks are used for sealing their mouths

There are various type of machines Some are hand-operated providing for the filling of one bottle at a time, others for three bottles at a time Now a-days elaborate machines have been devised to save manual labour and ensure greater output

The filling process depends upon the type of machine employed In small hand machines the bottles are filled by hand leaving a small space at the top The bottles are then placed and tightly screwed in the bottling stand of the soda water machine The mouth of the bottle is then closed by a rubber lid which is connected by a pipe with the gas cylinder provided with a pressure gauge and regulator The regulating nut is adjusted till the pressure of the gas as registered by the pressure gauge reaches about 120 lbs. The gas is allowed to enter the bottle at this stage For securing perfect aeration of the soda solution, the bottle is given a number of quick turns with jerks in a vertical plane Stop revolving the machine with the bottle in the inverted position The high

pressure of the gas at the mouth of the bottle prevents the water from coming out The supply of gas is then hastily cut off The pressure from outside being thus withdrawn the gas inside the bottle expands and as a result of this the glass balls are projected with violence towards the rubber rings in the mouths of the bottles which are thus sealed The bottles are again given three or four turns and then unlocked from the bottling stand

In big machines the filling operations are done automatically The bottles are simply placed on the bottling stand The mouths of the bottles are put in connection with the gasometer from which the soda solution comes automatically by syphon arrangement into the bottles The process of aerating the solution in the bottles is the same as before

Special machines are required for inserting the crown corks into the bottles The soda solution is charged as before and the machine is so constructed that crown corks can be driven into the mouth of the bottles without allowing the gas inside the bottle to escape

DETAILED PROCESS

The detailed method of working with machines follows —

The solution pan is filled with solution of soda— about one ounce of bicarbonate of soda to 2 gallons of

water Usually this solution is made in a large cistern of slate, or wood lined with lead, from which it is conveyed to the solution pan by means of a pipe and tap The gasometer tub is filled with water up to a constant level, above which the opening of the pipe coming from the solution pan is kept, while the other pipe connected with generator, is kept well under the water The bell of the gasometer being down, about 14 lbs of powdered whiting is mixed with water, to the consistency of cream, and poured into the generator till it is about two-thirds full, when it is carefully closed. Next screw the leaden acid bottle on to the generator Take off the small cap on the top of bottle, and put in about a quart of diluted sulphuric acid—half acid and half water—and replace the cap This should be mixed in an open vessel Muriatic or nitric acid may be used, if sulphuric acid cannot be obtained Swing the bottle slightly round, causing a little acid to fall into the whiting and water, at the same time turning round the agitator, the handle of which is on the top of the generator As soon as the acid is mixed with the whiting, carbon dioxide is generated and passes up the pipe into the rising bell, which it elevates by its pressure The end of the other pipe is turned down below the surface of the water, so that the gas passing through it may become cooled and purified The operation of

making the gas should be conducted slowly, the acid bottle being so moved that only a small quantity of acid falls into the generator at a time, otherwise the gas would be generated too quickly, and throw the whiting and water into the pipe, and probably injure the generator

The gas-tap and water tap are provided with index plates, which regulate the supply of gas and water to the pump of machine, they must be partly opened or closed by the person working the machine to suit the requirements. The machine must not be worked with the water tap open alone The machine being set to work, the gas is drawn down the pipe which stands above the level of the water, through the other pipe, and is forced into the condenser, where an agitator, worked by the spur wheel, revolving rapidly mixes it with the water which is drawn from the solution pan in like manner When the pressure is up the safety valve will lift, and soda water may be bottled

CAUTIONS

When the addition of acid and the turning of the agitator fail to produce more gas, then the whiting is exhausted, and must be removed It is important that this should be done after each time of using, before the whiting sets hard, or there will be a difficulty in

getting it out, and a liability of straining or breaking the fan of the agitator

On the first time of using there will be a quantity of air in the bell, which is discharged by opening the cock. When the gas has a pungent smell, it is fit for use

SALINE DRINKS

Saline drinks such as lithia water are made in the same way as soda water with the exception that sodium bicarbonate is replaced by suitable mineral salts, the carbon dioxide acting as a preservative For lithia water add lithium carbonate 80 grains to a gallon of water, for potash water add 66 grains of potassium carbonate to one gallon of water, for biarls water add 110 grs. of biarls salt to one gallon of water for vitchy water add 440 grains of vichy to a gallon of water, for radiarls water use 110 grains of radiarls to one gallon of water, for seltzer water add 110 grains of seltzer salt to one gallon of water, and so on. During the aeration of the water the pressure may be rendered a little low, say about 110 lbs.

SWEET DRINKS

Sweet drinks like lemonade are made by aerating a simple syrup to which the suitable flavour or essences have been added. A simple syrup is made by dissolving sugar, sachharine, water A simple method is to prepare a syrup by dissolving 3 lbs of sugar in 6½ pints of water

This is brought to a boil In the meanwhile 22½ grains of sodium bicarbonate are dissolved in water and into this solution 45 grains of saccharine are added gradually, stirring the solution all the while The saccharine being completely dissolved, the saccharine solution is added to the boiling syrup This would make 1 gallon of syrup of 23 Twadd in density but equal to 45 Twadd in sweetness

LEMONADE

To make lemonade, add to 1 gallon of plain syrup 2½ oz of citric acid, 1½ oz of essence lemon and ¼ oz of salicylic acid Both the citric and salicylic acids should be dissolved in water in glass or earthen vessels before being added to the syrup All the ingredients should be added only when the syrup is cold It is good if the essences and the colours, if any, are added just before the solutions are aerated under pressure of 100 lbs and bottled up

GINGERADE

To make gingerade, add to 1 gallon of simple syrup 1 oz of Ess stone ginger beer, ¼ oz of Ess Jamaica ginger, 1 dr of Ess of capsicum, ½ oz of salicylic acid previously dissolved in water, and colour to suit Add the essences to cold syrup just before aeration under a pressure of 80 to 100 lbs A little liquid foam may be added for froth heading

MILK SUGAR.

MILK sugar, from which homeopathic globules are manufactured, are in pretty big demand among the homeopathic practisioners The manufacture of milk sugar may therefore form a profitable small industry in the country

This is also used in modifying milk for feeding infants and invalids, as a diluent in various strong drugs in the preparation of medicinal powders, and in the manufacture of pentanitrolactose, which forms a part of some high explosives

History.

Milk sugar is said to have been discovered by accident early in the eighteenth century by a peasant in Switzerland who was making cheese The cheese having been hung up in a bag to drain for some time, this observing Swiss noticed a few crystals that had been formed by the evaporation of the whey A druggist, to whom these crystals were shown, predicted that, if the product could be manufactured in quantities, it would become an important article of commerce In the first half of the nineteenth century, milk sugar was being manufactured by very crude methods in Switzerland,

Holland and Germany The sugaring processes occupied about fourteen days, and the product then contained many impurities But there was great demand for even this impure product and the industry grew Switzerland controlled the milk sugar industry, and supplied the markets of the world

METHODS OF PREPARATION

Milk sugar or lactose is probably found in the milk of most mammals, and, so far as known, is found nowhere else in nature The milk sugar of commerce is derived from cows' milk of which it forms about five per cent It is but slightly sweet, hardly hundredth as sweet as cane sugar

Several methods of its manufacture are described below —

(1) The bulk of the fat of milk is removed by a separator for butter making, and the "separated' milk heated to from 75° to 85°C, and treated with 10 p c of milk of lime, whereby the residual fat and casein are precipitated Saturation with carbon dioxide follows as in the purification of beet root juice, and the purified liquid is concentrated and the milk sugar crystallised It may be purified by dissolution in water and precipitation by alcohol This may be regarded as a purely pharmaceutical preparation

(2) The manufacture of crystallized milk sugar has developed greatly in recent years, and a perfectly white well-crystallized product is now obtained. For its preparation, the sweet skim milk as it comes from the cream separator is precipitated with acetic acid, filtered, and boiled either in open steam-heated evaporators or in vacuum pans This first boiling should take several hours The whey during the boiling becomes more cloudy, but suddenly clears, and the remaining albuminoids will separate in large flocks that can readily be filtered It is to be filtered hot and boiled to crystallization in a vacuum pan The raw sugar so obtained can be refined and made white by a process similar to that described above

(3) On a small scale it is best to precipitate the protein from milk or whey by as small a quantity of acid mercuric nitrate as possible The clear filtrate is neutralised with dilute caustic soda solution till a very faint tinge is given with phenolphthalein, it is filtered from the precipitate thus produced, which consists of mercury salts Sulphuretted hydrogen is passed through the clear solution to remove the mercury oxide dissolved by the sugar, and, after filtration from mercuric sulphide, the sulphuretted hydrogen is expelled by boiling On evaporating the solution, milk sugar crystallizes out crystallisation may be hastened by vigorous stirring of

the concentrated solution while it is being rapidly cooled

(4) Whey, acidified to about one per cent of hydrochloric acid, is heated in large vats to the boiling point with steam This precipitates the albumen The solution is then made neutral with calcium hydroxide, evaporated in a vacuum pan to a syrupy consistency (25° Be) and filtered through a series of cloths in a high pressure filter press When sufficient syrup has accumulated, it is again run into the vacuum pan and evaporated, at about 110°F, to a much richer syrup This latter is drawn out into shallow boxes, where it cools and crystallizes, in 24 to 48 hours, into what appears to be a yellow sand This is crude sugar, and must be refined by repeated recrystallisation

(5) Sugar of milk is prepared by the addition of diluted sulphuric acid to the whey of cows' milk, and by subsequent evaporation, the albuminous matter is coagulated, this is filtered out and the liquid set aside to crystallize Animal charcoal is sometimes used to decolorize the solution

LENS MAKING.

A LENS is a piece of a transparent substance fashioned into a shape affording two regular opposite surfaces, both curved or one curved and the other plane

The chief uses to which lenses are put are in the making of optical instruments such as telescopes and microscopes and in the manufacture of spectacles.

Classification of Lenses

According to their curvature, they are either spherical, cylindrical, elliptical, or parabolic. The curved surfaces are usually spherical. Those used in optics are always spherical They are usually made either of crown glass, which is free from lead, or of glass, which contains lead, and is more refractive than crown glass.

Implements for Lens Grinding

Lenses are so ground that their faces shall form a portion of a spherical surface. The implements employed are, first, a concave shell of cast iron. This is cut from a wooden pattern of the true curvature of the lens, formed by means of a templet having a radius equal to that of the required curve, and by it, with the aid of coarse emery, the lens is ground approximately to the true form. Two templets, one convex and the other

concave, are made of sheet brass or copper, or for large sized lenses, of crown glass These serve as guides for turning what are technically known as the *convex and* concave tools to a proper sphericity

GRINDING OPERATION

The piece of glass of which the lens is formed is clipped around the edges to bring it to a circular form by means of flat pliers of soft iron, which does not slip from the glass as steel would, leaving it of somewhat greater diameter than the finished lens, and is then attached by means of cement, to a concave, circular hold fast, somewhat smaller than the lens The concave shell is now used for bringing the glass to a spherical surface For this purpose emery is employed, coarser at first and then finer, as the face of the lens begins to assume its true form The shell is turned both circularly and transversely on the lens, so as to bring the two surfaces in contact in every possible position in order to insure perfect sphericity From time to time the concave tool is ground in a similar way upon the convex tool in order to preserve the correctness of its surface

A "runner" of the cast iron of about half an inch less radius than the templet, is sometimes used as a support for common glasses, a number of which are ground together

LENSES FOR RIMLESS SPECTACLES.

When they are intended for rimless spectacles and eyeglasses, edging is often done by an automatic edging machine. This primarily consists of a grindstone with a front attachment which will grip the lenses and rotate them against a rimming grindstone until they are ground to a size determined by a gauge plate attached. The lenses are placed on a templet taking care that the centre markings and horizontal line of the lens correspond exactly with similar indications on the templet.

When, however, the lenses are edged by hand, there is the chance of the ink markings being removed by fingers. It would be advisable, therefore, to have a tiny diamond scratch which just shows on the edge after the lens is finished.

POLISHING LENSES

The lens is polished in one of the iron shells, the interior of which is coated with cement, over which a piece of cloth is placed and pressed into shape by the convex tool This is covered with putty powder (peroxide of tin). The manipulations are similar to those just described. Finally, the edges of the lens are ground to their true diameter.

Another contrivance for polishing lenses and other bodies of spherical form consists of a cup connected by

a ball and socket joint and a bent arm, with a rotating upright shaft set concentric to the body to be polished The cup, being set eccentrically on the joint, has an independent rotation at the same time that it revolves around the common axis. This prevents any part of the surface of the cup from coming repeatedly in contact with the same parts of the body which is being ground or polished

POLISHING PAPERS.

HERE *is an industry that can be begun in a small way*

We all know how useful sand papers are and what a great demand for them exists There are several other papers of this type, viz, glass paper, emery paper, etc. These are all used for rubbing down and smoothing the surface of wood, horn, etc., and even metal The principle underlying the manufacture of all of them is the same

Grades of Fineness

The polishing paper should be thick and tough, and is made in sheets and rolls The polishing material is taken in the form of powder and attached to the paper by an adhesive, glue being usually employed. There are different degrees of coarseness which are essential But each, in itself, is uniform.

Naturally these papers are to be judged as regards their efficacy by

(1) the sharpness and hardness of the coating material, and

(2) the dimensions of the particle

Thus the grades of fineness vary considerably, coarser papers are put to rough uses while the finer ones are used for smoothing purposes

GLASS PAPER.

Glass paper is best suited for rubbing down woods, ivory, tortoise-shell, bone, mother of-pearl, oil and water paint varnishes, etc. In a word, it is used to polish any substance softer than itself. The finely powdered glass employed acts like an extremely fine file

GRINDING GLASS.

As glass paper is required to be manufactured in different degrees of fineness, it is of utmost importance that the powdered glass should be graded accordingly On a small scale the glass may be pulverised by pounding with a heavy iron pestle in an iron mortar. For this purpose all kinds of waste but clean glass—technically known as *cullet*—may be used. If there be any dirt, oil or paint, first boil them with caustic lye to remove greasy matters In large quantities, the glass is generally pound in mill stones

On a manufacturing scale, however, it is preferable to use a power-driven "Stamp Mill" This consists of a fixed chest with cast iron sides forming the support for the mechanism The chest is closed in by means of wooden doors The bottom is also of cast iron Inside the chest, there are two iron cylinders turned true inside. These revolve intermittently about an inch at a time, after each stroke of the stamps These stamps,

on their turn, rotate on their own ores The glass is pounded by the impact of these stamps With the help of this machine the different degrees of fineness required are assured Charge the iron cylinders with cullet, close the doors and set the stamps going When the powder has been crushed, stop the machine, remove the contents, and recharge the cylinders

Sifting the Particles

The next important step is that of "sifting" On a small scale this may be effected with the help of pieces of linen On a large scale sieves of different mesh may be used A note of caution should be sounded here As the superfine particles of glass suspended in the air cause dangerous illness, persons engaged in sifting must have their mouths and nostrils properly covered

On a manufacturing scale, however, a sifting machine may be employed The general type consists of a closed wooden chest containing a cylindrical wooden frame This is covered with wire gauze and set in rotation by a belt pulley The material to be screened is automatically fed by mechanical arrangements. There is a fan inside the screening cylinder which sets up a current of air facilitating the sifting process thereby The glass powder is placed in a hopper at the top and finds its way into the cylinder The fine particles fall to the bottom after traversing the screen. The coarser portions

remain in the cylinder As the screenings are required to be graded in one machine, there are provisions for a number of interchangeable cylinders with different mesh

SELECTING AND GLUEING THE PAPER

In making polishing papers, selection of the proper standard of paper is essential This should be as strong and long stapled as possible It should further contain the minimum quantity of wood pulp, otherwise, it will easily tear away Moreover, it should be fairly thick, and lastly, free from lumps and irregularities A flat surface must be ensured, otherwise everthing will be spoiled

Cut the paper into sheets of the requisite size Lay them on a table and fasten down with pins at the corners Then with a broad brush coat the pieces thinly, evenly with hot glue As the glue soon thickens becoming stringy, difficulty is met with in its distribution. The operation must be mastered after a few trials To obtain the most satisfactory results the glue must be of the best quality and of suitable consistency This depends upon the grades of the powder and qualities of the paper used The thin glue will soak in poor paper while the thick glue will dry quickly forming a hard coating Again, if the glue is distributed unevenly, thick and thin streaks will appear at places.

SPRINKLING THE POWDER.

Immediately after the glue has been applied, dust the powdered glass over the surface with the help of a small hand sieve This operation should require some care in the beginning Continue the sprinkling until the paper seems to be covered evenly all over To remove any superfluous powder simply turn the sheet over The loose powder lying over the surface will fall Then run lightly a wooden roller over the sheet This is to press the glass into the glue and smoothen the surface Lastly, hang up the paper to dry

On a large scale however the above processes of glueing and sprinkling may be effected with the help of machineries

Name of the manufacturer or trade mark may be printed on the back of the paper before hand with the help of a stencil

PUMICE PAPER.

Pumice papers are manufactured in the same way as above Coat strong paper with glue and sprinkle it with pumice powder of various degrees of fineness. Another method is as follows Calcine a quantity of pumice stone in a crucible Then quench in water and pound to a fine powder Stir up the latter to a thin, workable pulp with some good boiled oil If a yellow

coating is desired, add a little ochre to the mixture, if a bluish red colour, use colcothar and lampblack Apply a thin, even coating of this pulp to strong packing paper with a brush See that the paper is covered all over, and leave the whole to dry Give a second coating afterwards. When this is dry, run the paper between rollers This is to smoothen the surface as much as possible Stir the mass constantly in order to preserve its homogeneity This will also prevent the tendency of the pumice to settle down from the varnish

This paper is suitable for polishing rusty iron and steel, to which it will impart a perfectly bright surface

This paper is put to the same uses as glass paper It is however, of much harder material, and as such does not wear out quickly It needs using with great care

SAND PAPER AND EMERY PAPER.

Proceeding exactly as in the preparation of glass paper fully described above, sand or powdered flint may be graded by sifting, and then applied to paper coated with glue

To prepare sand papers and emery papers use should be made of glues of the highest attainable viscosity The paper is passed between rollers which supply a rather concentrated solution of the glue to the upper surface, and the sand or emery (garnet, carbo-

rundum, alundum, etc.) of the selected size of grain is sprinkled profusely upon it. The excess of sand is shaken off and the paper is then passed slowly along to a second set of rollers which it reaches in about half an hour In passing through this second set it is again treated with a layer of the same glue, but of a weaker concentration which binds the sand firmly that it may not become easily loosened. The paper is then passed slowly over heated pipes for about an hour and then wound into rolls, or cut to appropriate sizes and baled.

GLOBE MAKING.

TO the average school boy the globe is a familiar apparatus to-day Geographical lessons are sought to be impressed upon them with its help With the spread of primary education in India, globes in vernacular languages will naturally be in great demand in the coming years Their manufacture may therefore be taken up as a profitable small industry requiring comparatively little outlay of capital The qualifications needed in the beginner are a skilful hand, efficiency in drawing and painting, knowledge of map reading besides aesthetic taste and common sense

Mould for Globes

Globes are made of paper and plaster shaped upon a model or mould The mould is turned out of a piece of wood, and has for an axis a piece of iron wire at each pole Strips of any strong paper are steeped in water and kept ready at hand The model is first covered entirely with the wet paper strips The unevenness caused by overlapping are of no consequence The saturated paper covering formed as above is immediately covered over with a layer of pasted paper, also cut in long narrow strips This last process is repeated for half

a dozen times using white and brown paper alternately That will suffice for a globe of moderate size, but for larger ones the process must be carried on a little further The wet pasteboard ball thus obtained must be dried now For this purpose it is placed upon its axis in a rack.

The enclosed model has got to be extricated To this end the wooden mould with its solid paper covering is placed on its axis.

HOW GLOBES ARE MADE.

Then a sharp cutting instrument, fixed on a bench is brought into contact with the surface of the sphere which is made to revolve. The pasteboard ball is thereby quickly cut into two hemispherical bowls. Now within every globe there is a piece of wood which is exactly equal to the inside diameter A thick wire runs through this wood and sometimes projects, some 2 or 3 inches at each end This wooden ruler is fixed upright in a vice One of the hemispheres is now nailed to the upper end of the ruler upon which it rests and the wire is then passed through its centre The ruler is now reversed and the circular edge of the fixed half of the globe is rapidly besmeared with strong glue The second hemisphere is now similarly nailed on the open end of the ruler and the free end of the wire is passed through the centre as before Great care is to be taken in bringing

the edges of the two halves into contact so that they may adhere to each other strongly.

In this way a paper globe is obtained possessing its own axis.

PLASTERING THE GLOBE.

The paper globe is next placed on its axis in a frame, of which one side is a semi-circular piece of metal. A coating of whiting, glue, and oil is applied to its surface. The operation is repeated half a dozen times allowing for periods of drying By this treatment the globe will have become a paper sphere enveloped in another sphere of plaster If on trial it be found not to revolve quite equably on its axis, a few shots may be introduced into the portions which are too buoyant, thus ensuring balance.

FITTING THE MAP.

All this is comparatively easy work, the more delicate task remains to be achieved The polished globe is held conveniently for the purpose of marking it with latitudes and longitudes (The lines of direction to be subsequently covered up with lithographed strips). These lines are struck with great rapidity and with mathematical exactitude by an instrument known as "Beam Compass." The sphere is now ready for receiving the map which is lithographed in as many as fourteen

distinct pieces The Arctic and Antarctic poles form two circular pieces, from which the lines of longitud- radiate They are fitted and pasted in their proper places

The remaining dozen pieces are then selected one by one, in order, and pasted in juxtaposition Each piece is fitted precisely to the space alloted to it on the sphere, its bounding latitude and longitude correspond ing with those previously marked on the surface The paper upon which these portions of the earth's surface are lithographed for the above purpose is thin and extremely tough. It is rubbed down with the greatest care, through all the stages of this pasting process. The result will be a globe covered with a plain map, so perfectly joined that every line and every letter fit toge ther as if they had been engraved on one piece

One would naturally require long experience of working in this line to suitably match the pieces of map One would then learn how to define the various boun daries, blue island, green oceans, black mountains, the communication between the different regions and the like

VARNISHING AND MOUNTING THE GLOBE.

After the fitting and pasting have been finished, the globe is varnished with a preparation known in the trade

as white hard, to which some softening matter is added to prevent the varnish cracking The work is completed on the application of four successive coats of varnish with intermediate drying Finally the globe is to be mounted The brass meridian ring must be previously graduated with accuracy, on this the axis of the globe revolves Of course, it is absolutely necessary that poles should be exactly parallel The globe may preferably be mounted by a cabinet maker